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TRANSACTIONS

OF THE

AMERICAN CLIMATOLOGICAL ASSOCIATION.

FOR THE YEAR 1911.

VOLUME XXVII.

"The object of this Association shall be the study of Climatology and Hydrology and of Diseases of the Respiratory and Circulatory Organs."—*Constitution.*

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PHILADELPHIA:

PRINTED FOR THE ASSOCIATION.

1911.

NOTICE.

The Association assumes no responsibility for the statements and opinions expressed in the papers read at its meetings.

OFFICERS OF THE ASSOCIATION.

Presidents.

JOHN WINTERS BRANNAN, M.D., New York City, 1911.

ALEXANDER D. BLACKADER, M.D., Montreal, 1912.

Vice-Presidents.

WILL H. SWAN, M.D., Colorado Springs, Col., 1911.

JOHN H. LOWMAN, M.D., Cleveland, Ohio, 1911.

H. M. KING, M.D., Loomis, N.Y., 1912.

C. E. EDSON, M.D., Denver, 1912.

Secretary and Treasurer.

GUY HINSDALE, M.D., Hot Springs, Va.

Representatives on the Executive Committee of the Congress.

Dr. ROLAND G. CURTIN, Philadelphia.

Dr. THOMAS DARLINGTON, New York, *Alternate*.

Committee of Arrangements, 1911.

Dr. A. D. BLACKADER, 236, Mountain Street, Montreal.

Council.

THOMAS DARLINGTON, M.D., New York.

THOMAS D. COLEMAN, M.D., Augusta, Ga.

CHARLES E. QUIMBY, M.D., New York.

EDWARD R. BALDWIN, M.D., Saranac Lake, N.Y.

JOHN W. BRANNAN, New York.

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LIST OF OFFICERS.

Presidents.

NAME	YEAR
A. L. Loomis	1884–5
William Pepper	1886
Frank Donaldson	1887
A. L. Loomis	1888
V. Y. Bowditch	1889
Charles Denison	1890
F. I. Knight	1891
W. E. Ford	1892
R. G. Curtin	1893
A. H. Smith	1894
S. E. Solly	1895
J. B. Walker	1896
E. Fletcher Ingals	1897
E. O. Otis	1898
Beverley Robinson	1899
Abraham Jacobi	1900
Robert H. Babcock	1901
Samuel A. Fisk	1902
Norman Bridge	1903
James C. Wilson	1904
W. F. R. Phillips	1905
E. L. Shurly	1906
Thomas Darlington	1907
Thomas D. Coleman	1908
Charles E. Quimby	1909
Edward R. Baldwin	1910
John Winters Brannan	1911
Alexander D. Blackader	1912

Vice-Presidents.

NAME	YEAR
F. I. Knight, W. H. Geddings	1884–5
Frank Donaldson, Beverley Robinson	1886
V. Y. Bowditch, R. G. Curtin	1887
A. Y. P. Garnett, J. T. Whittaker	1888
J. R. Leaming, E. T. Bruen	1889
A. L. Gihon, H. B. Baker	1890
E. L. Trudeau, T. S. Hopkins	1891
E. Fletcher Ingals, Beverley Robinson	1892
A. H. Smith, E. O. Otis	1893
I. Hull Platt, E. L. Trudeau	1894
John H. Musser, G. R. Butler	1895
Charles E. Quimby, James A. Hart	1896
S. A. Fisk, John C. Munro	1897
Beverley Robinson, C. F. McGahan	1898
James A. Hart, R. C. Newton	1899
R. H. Babcock, J. W. Brannan	1900
Albert C. Peale, S. W. Langmaid	1901
Norman Bridge, W. F. R. Phillips	1902
James C. Wilson, H. S. Orme	1903
Thomas Darlington, Thomas D. Coleman	1904
S. G. Bonney, S. D. Risley	1905
A. D. Blackader, Henry Sewall	1906
Frank Fremont-Smith, C. L. Minor	1907
Judson Daland, Charles Fox Gardiner	1908
E. R. Baldwin, C. E. Edson	1909
James M. Anders, H. Longstreet Taylor	1910
Will Howard Swan, John H. Lowman	1911
Herbert Maxon King, Carroll E. Edson	1912

Secretaries and Treasurers.

James B. Walker	1884–95
Guy Hinsdale	1895

LIST OF MEMBERS.

Honorary Members.

ELECTED

O. M. Orme, H. S., 214, Douglas Building, Los Angeles, Cal.
O. M. Reed, Boardman, Alhambra, Calif.
O. M. Robinson, Beverley, 42, West 37th Street, New York.
O. M. Schauffler, Edward W., Kansas City, Missouri.
1911. Stupart, Prof. R. F., Director, Dominion Meteorological Service, Toronto, Canada.
1885. Trudeau, Edward L., Saranac Lake, New York.
O. M. Tyndale, J. Hilgard, Richards Block, Lincoln, Nebraska.
1897. Weber, Sir Hermann, 10, Grosvenor Street, W., London, England.
1906. Weber, Leonard, 132, West 73rd Street, New York.
1897. Williams. Charles Theodore, 2, Upper Brook Street, W., London, England.

Corresponding Members.

1898. Eyre, G. G., Claremont, Cape Town, South Africa.
1910. Forbes, Mr. N. Hay, F.R.C.S., Church Stretton, England.
1911. Grenfell, Wilfred, C.M.G., St. Anthony, Newfoundland.
1910. Gros, E. L., 23 Ave. du Bois de Boulogne, Paris, France.
1910. Lamb, George, Indian Medical Service, Parel, Bombay, India.
1898. Liceaga, Eduardo, Ca. de Napoles, Numero 37, Mexico.
1908. Liston, W. Glen, D.P.B., Capt., Indian Medical Service, Parel, Bombay Bacteriological Laboratory, Bombay, India.
1898. Orvananos, Domingo, 25, Chavarri Street, Mexico.
1910. Rogers, Leonard, I.M.S., F.R.C.S., School of Medicine, Calcutta, India.
1904. Sandwith, Fleming Mant, 31, Cavendish Square, W. London.

O. M., Original Member.

ELECTED

1898. Sunderland, Septimus, 11, Cavendish Place, Cavendish Square, W., London.
1902. Weber, F. Parkes, 19, Harley Street, W., London.
1907. Wellman, F. Creighton, Tulane University, 1551, Canal Street, New Orleans, La.
1907. Williams, Leonard, 123, Harley Street, W., London.

Active Members.

1888. Abbot, Griffith E., Leominster, Mass.
1897. Alton, Charles D., 1310, Asylum Avenue, Hartford, Conn.
1898. Anders, Howard S., 2035, Walnut Street, Philadelphia.
1899. Anders, James M., 1605, Walnut Street, Philadelphia.
1890. Anderson, B. P., 106, N. Cascade Avenue, Colorado Springs, Col.
1900. Arnold, Horace D., 427, Beacon Street, Boston.

1893. Babcock, R. H., 44, Bellevue Pl., Chicago.
1898. Baldwin, Edward R., Saranac Lake, N.Y.
1901. Barlow, W. Jarvis, Security Building, Los Angeles, Cal.
1907. Barnes, Harry Lee, Wallum Lake, R.I.
1902. Bergtold, William H., 1460, Clayton Street, 610, California Building, Denver, Col.
1906. Billings, John S., jun., 32, East 53rd Street, New York City.
1897. Blackader, Alexander D., 236, Mountain Street, Montreal, Canada.
1895. Boardman, W. S., 63, Mt. Vernon Street, Boston.
1897. Bonney, S. G., Stedman Building, Denver, Col.
1885. Bowditch, V. Y., 506, Beacon Street, Boston.
1901. Bracken, Henry Martyn, 1010, Fourth Street, Minneapolis, Minn.
1891. Brannan, John W., 11, West 12th Street, New York City.
1894. Bridge, Norman, Temple Auditorium, Los Angeles, Cal.
1903. Brown, Lawrason, Saranac Lake, N.Y.
1903. Brown, Philip King, 350, Post Street, San Francisco, Cal.
1897. Brown, Sanger, Reliance Building, Chicago.
1907. Browning, Charles C., Story Bldg., Los Angeles, Cal.
1909. Bushnell, George E., U.S.A., Fort Bayard, New Mexico.
1886. Butler, G. R., 229, Gates Avenue, Brooklyn.

ELECTED

1896. Campbell, W. A., 424, N. Nevada Ave., Colorado Springs, Col.
1910. Carrington, P. M., U.S.M.H. and P.H. Service, Port Townsend, Wash.
1898. Casselberry, W. E., 34, Washington Street, Chicago, Ill.
1906. Claytor, Thomas A., 1315, New Hampshire Avenue, Washington, D.C.
1898. Cleemann, Richard A., 2135, Spruce Street, Philadelphia.
1901. Cobb, J. O., U.S.M.H.S., 403, Iron Block, Milwaukee, Wis.
1894. Coleman, Thomas D., 505, Greene Street, Augusta, Ga.
1901. Collins, Charles Farnham, 50, West 55th Street, New York City.
1889. Coolidge, A., jun., 613, Beacon Street, Boston.
1902. Craig, R. W., Phœnix, Arizona.
1910. Crane, Bayard T., Rutland, Mass.
1885. Curtin, R. G., 22, South 18th Street, Philadelphia.

1907. Da Costa, John C., jun., 264, South 15th Street, Philadelphia.
1892. Daland, Judson, 317, South 18th Street, Philadelphia.
1890. Darlington, Thomas, 27, Washington Square, North, New York City.
1907. Darnall, W. Edgar, 1704, Pacific Ave., Atlantic City.
1897. Davis, N. S., 72, East Madison Street, Chicago.
1910. Dixon, Samuel G., Harrisburg, Penn.
1905. Dunn, William LeRoy, Asheville, N.C.

1897. Edson, Carroll E., McPhee Building, Denver, Col.
1903. Edwards, William, A., Security Building, Los Angeles, Cal.
1903. Elliott, J. H., 611, Spadina Ave., Toronto, Canada.
1892. Elsner, H. L., Fayette Park, Syracuse, N.Y.

1887. Fisk, Samuel A., Brimfield, Mass.
1910. Floyd, Cleaveland, 1398, Beacon Street, Boston Mass.
1885. Ford, Willis E., 266, Genesee Street, Utica, N.Y.
1911. Fulton, Frank Taylor, 169, Angell Street, Providence, R.I.

1896. Gardiner, C. Fox, 818, North Cascade Avenue, Colorado Springs, Col.

ELECTED

1886. Garnett, A. S., Hot Springs, Ark.
1898. Getchell, Albert C., 6, Linden Street, Worcester, Massachusetts.
1892. Gibson, William M., 260, Genesee Street, Utica, N.Y.
1909. Griffin, Walter Alden, Sharon, Mass.

1907. Hall, J. N., Jackson Building, Denver, Col.
1893. Hance, I. H., Lakewood, N.J.
1891. Hart, James A., Geneva, N.Y.
1900. Harvey, Thomas W., 463, Main Street, Orange, N.J.
1896. Heffron, John L., 528, South Salina Street, Syracuse, N.Y.
1893. Hinsdale, Guy, Hot Springs, Va.
1902. Hoagland, Henry W., 818, North Nevada Avenue, Colorado Springs, Col.
1905. Huddleston, John H., 145, West 78th Street, New York.

O. M. Ingals, E. Fletcher, 34, Washington Street, Chicago.

1889. Jacobi, A., 19, East 47th Street, New York.
1904. Jacobs, Henry Barton, 11, Mt. Vernon Place, W., Baltimore.
1888. Jayne, W. A., 416, McPhee Building, Denver, Col.
1901. Jennings, Charles Godwin, 457, Jefferson Street, Detroit, Michigan.

1910. Kahlo, George D., French Lick, Indiana.
1904. King, Herbert Maxon, Liberty, New York.
1907. Kinghorn, Hugh M., 14, Church Street, Saranac Lake, N.Y.
1899. Klebs, Arnold C., care of J. M. Forbes and Co., Sears Bldg., Boston.
1903. Kyle, D. Braden, 1517, Walnut Street, Philadelphia.

1910. Landis, H. R. M., 11, South 21st Street, Philadelphia.
1887. Langmaid, S. W., 277, Dartmouth Street, Boston.
1899. Le Fevre, Egbert, 52, West 56th Street, New York.
1903. Lindley, Walter, 1414, South Hope Street, Los Angeles, Cal.
1909. Locke, Edwin Allen, 311, Beacon Street, Boston, Mass.
1904. Lowman, John H., 1807, Prospect Ave., S.E., Cleveland, O.
1907. Lyman, David Russell, Wallingford, Conn.

ELECTED

1902. McBride, James H., Pasadena, Cal.
1909. Makuen, George Hudson, 1627, Walnut Street, Philadelphia.
1906. Manges, Morris, 72, East 79th Street, New York.
1910. Marcy, Alexander, Riverton, N.J.
1902. Marvel, Philip, 1616, Pacific Avenue, Atlantic City, N.J.
1887. Mays, Thomas J., 1829, Spruce Street, Philadelphia.
1905. Miller, James Alexander, 18, West 51st Street, New York.
1909. Miner, Charles H., 115, South Franklin Street, Wilkesbarre, Pa.
1909. Miner, Stanley G., 58, Cadillac Square, Detroit, Mich.
1899. Minor, Charles L., Asheville, N.C.
1909. Morgan, James Dudley, 919, Fifteenth Street, N.W., Washington, D.C.
1886. Musser, John H., 1,927, Chestnut Street, Philadelphia.

1900. Nammack, Charles E., 42, East 29th Street, New York.
1895. Newton, R. C., 42, Church Street, Montclair, N.J.
1907. Nichols, Estes, Y.M.C.A. Building, Portland, Maine.
1907. Nichols, John B., 1321, Rhode Island Ave., N.W., Washington, D.C.

1888. Otis, E. O., 381, Beacon Street, Boston.

1887. Peale, A. C., 605, 12th Street, N.W., Washington, D.C.
1906. Perkins, Jay, 106, Waterman Street, Providence, R.I.
1895. Phillips, W. F. R., Mobile, Alabama.
1887. Platt, Walter B., 802, Cathedral Street, Baltimore.
1902. Pottenger, F. M., O. T. Johnson Building, Los Angeles, Cal.
1905. Pratt, Joseph H., 313, Beacon Street, Boston.
1905. Pryor, John H., 26, Linwood Ave., Buffalo, New York.

1891. Quimby, Charles E., 278, West 86th Street, New York.

1885. Rice, C. C., 123, East 19th Street, New York.
1901. Richardson, Charles W., 1317, Connecticut Avenue, Washington, D.C.
1904. Richer, A. J., Ste. Agathe des Monts, Province of Quebec, Canada.
1890. Robinson, W. D., 2012, Mount Vernon St., Philadelphia.
1902. Rochester, Delancey, 469, Franklin Street, Buffalo, N.Y.

ELECTED

1892. Roe, John O., 44, South Clinton Street, Rochester, N.Y.
1890. Rogers, E. J. A., 222, Colfax Avenue, Denver, Col.

1905. Schauffler, William Gray, 400 Madison Ave., Lakewood, N.J.
1901. Sewall, Henry, 433-4, Majestic Building, Denver, Col.
1910. Shurly, B. R., 32, Adams Avenue W., Detroit, Mich.
O. M. Shurly, E. L., 32, Adams Avenue, W., Detroit, Mich.
1890. Smith, A. Alexander, 18, West 51st Street, New York.
1887. Smith, Frank Fremont, 1808, Massachusetts Ave., Washington, D.C.
1911. Steiner, Walter R., 4, Trinity Street, Hartford, Conn.
1909. Stevens, Martin L., Asheville, N.C.
1904. Stone, Arthur K., 543, Boylston Street, Boston, Mass.
1898. Stubbert, J. Edward, Suffern, New York.
1910. Swan, John M., Glen Springs, Watkins, New York.
1901. Swan, Will Howard, 1440, North Nevada Avenue, Colorado Springs, Col.

1892. Taylor, H. Longstreet, 75, Lowry Arcade, St. Paul, Minn.
1907. Taylor, J. Gurney, 6041, Drexel Road, Philadelphia.
1896. Taylor, J. Madison, 1504, Pine Street, Philadelphia.
1910. Thomas, John D., 1413, 20th Street, N.W., Washington.

1897. Whitcomb, H. H., Norristown, Pa.
1911. White, William Charles, Bedford Ave. and Wandless St., Pittsburg, Pa.
1898. Whitney, Herbert B., 320, Temple Court, Denver, Col.
1885. Williams, H. F., 416, Grand Avenue, Brooklyn.
1898. Williams, Harold, 528, Beacon Street, Boston.
1911. Williams, Linsly R., 884, Park Avenue, New York City.
1910. Wilson, Gordon, 1315, North Charles Street, Baltimore
O. M. Wilson, James C., 1509, Walnut Street, Philadelphia.

Total, 138 active members.

MINUTES.

The Twenty-eighth Annual Meeting of the Association was called to order by the President, Dr. John Winters Brannan, of New York, at the Windsor Hotel, Montreal, Canada, June 13, 1911, at 10 A.M.

The following members were present during the meeting:—

Dr. C. D. Alton,
Dr. H. S. Anders,
Dr. J. M. Anders,
Dr. E. R. Baldwin,
Dr. W. H. Bergtold,
Dr. A. D. Blackader,
Dr. V. Y. Bowditch,
Dr. H. M. Bracken,
Dr. J. W. Brannan,
Dr. Lawrason Brown,
Dr. Sanger Brown,
Dr. J. H. Elliott,
Dr. A. C. Getchell,
Dr. W. M. Gibson,
Dr. W. A. Griffin,
Dr. I. H. Hance,
Dr. G. Hinsdale,
Dr. J. H. Huddleston,
Dr. Geo. D. Kahlo,
Dr. H. M. King,
Dr. H. M. Kinghorn,
Dr. H. R. M. Landis,
Dr. E. Lefevre,
Dr. J. H. Lowman,
Dr. D. R. Lyman,
Dr. J. A. Miller,
Dr. C. H. Miner,
Dr. S. G. Miner,
Dr. C. L. Minor,
Dr. Estes Nichols,
Dr. J. B. Nichols,
Dr. E. O. Otis,
Dr. Jay Perkins,
Dr. J. H. Pratt,
Dr. A. J. Richer,
Dr. J. M. Swan,
Dr. H. Longstreet Taylor,
Dr. J. Madison Taylor,
Dr. Gordon Wilson,

There were present as guests Professor R. F. Stupart, Director Meteorological Service, Canada; Dr. Robert C. Paterson, Ste. Agathe, Canada; Dr. George D. Porter, Toronto; and Dr. Leonard Murray, Halifax.

Secretary and Treasurer's Report.

This Association has completed twenty-seven years of its existence. During the past year there have been the following changes in membership:—Dr. John L. Dawson, Dr. V. H. Norrie, Dr. F. H. Williams, Dr. Wilbur T. Little, and Dr. W. F. Chappell have resigned. We have lost three by death:—On October 19, 1910, Dr. James B. Walker, of Philadelphia, for ten years the Secretary and afterwards President of this Association; on September 13, 1910, Dr. Charles C. Ransom, of New York; and on February 18, 1911, Dr. R. J. Nunn, an honorary member, died at his home in Savannah, Georgia.

A memorial of Dr. Walker has been prepared by Dr. Curtin (see pp. xxiv-xxvi).

Financial Statement.

Balance in hand, May 2, 1910	$224.17	
Received from annual dues	967.50	
Total	$1,191.67	
Expenses		$831 77
June 1, 1911. Balance in hand		359.90
		$1.191.67

The twenty-sixth volume of Transactions has been printed and distributed. This has been sent to members of all grades, and to the principal libraries and medical journals in America and Europe. For ten years we had a favourable arrangement with the *Journal of Balneology and Climatology* in the publication of our Transactions, by which very many of our papers were printed in that Journal. Since the formation of the Royal Society of Medicine by a union of a number of British societies, the Journal has been discontinued, and the Balneological and Climatological Society, with which we have had most cordial relations, has ceased to exist. The Secretary recommends that the present system of publication be continued.

It is especially desired that any members planning to attend the International Medical Congress against Tuberculosis, at Rome, in September, should make it known in order to be qualified as delegates. [Dr. Otis and Dr. Richer were appointed.]

The Secretary was asked by the Secretary of the Interior Department if he would serve as a national delegate to the Fifth International Congress on Thalassotherapy, held at

Kalberg, Germany, June 5 to 8, 1911, but he was unable to accept the appointment. The following topics have been announced for consideration: Effects of oceanic climates upon the human organism; Effects of sea bathing upon the human organism; Reports of special investigations. It would be gratifying if we could send a delegate to this Congress next year.

A number of members have forwarded to the Secretary excuses for their failure to attend the present meeting. This is true of our members west of the Rockies, owing to their activities in connection with the meeting of the American Medical Association this month. It also happens that another large meeting will be held in Denver shortly, and that some State societies and college commencements interfere with a fuller attendance at this session.

Many members feel that due consideration is not given them in choosing the time and place of our meeting. It so happened this year that this Association voted to meet in Montreal, and the American Medical Association later on voted to meet in California. Hence it is that we should leave the time and place of our meeting absolutely to the Council, where the constitution places it, and not delegate this matter to the nominating committee, as has been done in the past.

Another thing that destroys the efficiency of the Council is to elect members widely separated by possibly thousands of miles, and with no likelihood that they will attend its meetings. At the midwinter Council meeting the principal business of the Association is transacted, and, aside from the President and Secretary, only two other members were present at the Council. The greatest difficulty was experienced in arranging the time for this meeting; various protests were received, and we finally settled on dates which, after all, could not suit everyone.

We call your attention to the change in Article III, Section 1, proposed at the last meeting, so as to read:— "This Association shall consist of active, corresponding, and honorary members, the former not to exceed 150 and the latter not to exceed twenty (20)."

(Signed)

E. R. Baldwin.
G. Hinsdale.

We have also received the following proposed change in Article II, making it read as follows:—

"*Article* 2.—The object of this Association shall be the Study of Climatology and Hydrology, with particular reference to Hydrotherapy and to Diseases of the Respiratory and Circulatory Organs, and to such other diseases as may be associated with or related to the foregoing subjects."

R. H. Babcock,
G. Hinsdale.

This Association has paid its assessment for the expenses of the last Congress of American Physicians and Surgeons, amounting to $125. This assessment, however, ought not to be so large and such a large expense would not fall upon the Society if all those in attendance at the Congress would register and pay their dues as members of the Congress. The Secretary is furnished with a list of such members failing to pay; but all the societies are, more or less, to blame.

In arranging the present meeting we have had the unremitting labour and active services of our member, Dr. Blackader, who is the Committee of Arrangements *in toto*. He has had many difficult problems, but we trust they have all been solved successfully.

The following have sent excuses for non-attendance: Messrs. G. Orme, Bridge, Barlow, Bonney, Bridge, P. K. Brown, Browning, Bushnell, Carrington, Cleemann, Cobb, Edwards, Fisk, Garnett, Heffron, Ingals, Klebs, Kyle, Lindly, Marcy, McBride, Marvel, Platt, Pottenger, Reed, Schauffler, Sewall, E. L. Shurly, Fremont-Smith, H. F. Williams, Harold Williams, W. H. Swan, W. F. R. Phillips, W. S. Boardman, Coleman, Campbell, W. D. Robinson, J. E. Stubbert, Jacobi, C. F. Collins.

We call attention of all members, particularly those who have been absent from three successive meetings, to Article III, Section 4, relating to membership. It is vital to the efficiency of the Society that members attend or contribute papers.

We continue to receive as exchanges the publications enumerated in vol. xxiv, p. 18.

The resignations as read were accepted.

The President appointed as a Nominating Committee:

South end of Lake Placid Club, shore of Mirror Lake. West end of Forest (winter) Clubhouse. Sentinel Mountains.

Dr. V. Y. Bowditch, Dr. C. L. Minor, Dr. J. E. Elliott, Dr. L. Brown, and Dr. Gordon Wilson; as an Auditing Committee: Dr. Otis and Dr. Madison Taylor.

The Secretary read the report of the Council on recommendations for membership. The morning session was then adjourned. At the conclusion of the afternoon session, the members and accompanying ladies enjoyed a drive to Mount Royal, by courtesy of Dr. Blackader and his friends. The annual dinner was held at the Windsor Hotel. At the conclusion of the morning session on June 14, the Auditing Committee reported that they had examined the Treasurer's books and found the accounts correct. The nominating Committee reported recommendations as follows:—

For President, Dr. A. D. Blackader, of Montreal; for Vice-Presidents, Dr. H. M. King, of Loomis, New York; and Dr. C. E. Edson, of Denver; for Secretary and Treasurer, Dr. Guy Hinsdale, of Virginia Hot Springs; for Member of the Council, Dr. J. W. Brannan, New York.

The officers as recommended were unanimously elected. The following were elected to membership: On the honorary list, Dr. Boardman Reed, of Alhambra, California, an original member of the Association; on the corresponding list, Dr. Wilfred T. Grenfell, C.M.G., of Newfoundland and Labrador; on the active list, Dr. William Charles White, Pittsburg; Dr. Walter R. Steiner, Hartford; Dr. Frank T. Fulton, Providence; Dr. Linsly Williams, New York.

In accordance with the resolution offered at the last annual meeting, Article III, Section 1, was amended so as to read:—

"This Association shall consist of active, corresponding, and honorary members, the former not to exceed 150, and the latter not to exceed twenty (20)."

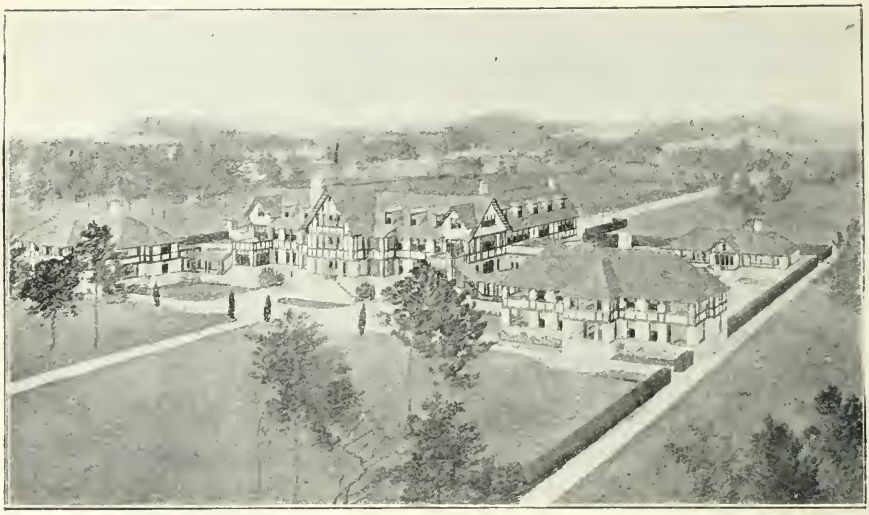
The names of those who have been proposed for election as active members in 1912 were then read by the Secretary and the list closed.

A resolution was unanimously passed thanking the President of the Association and the Chairman of the Association and the Chairman of the Committee of Arrangements, his professional friends in Montreal, and the manager of the Windsor Hotel, for their successful efforts in arranging

Lake Placid Club, Station Road, near Golfhouse.

a most enjoyable meeting. A resolution was also passed thanking the members living at Saranac Lake for their entertainment at Saranac Lake and Lake Placid. A resolution was passed thanking the Medical and Surgical Staff of the Royal Victoria Hospital, Montreal, for their courtesy in giving a luncheon to the Association on the last day of the meeting.

The Association then adjourned.



Laurentian Sanatorium,

On June 12, the day before the Annual Meeting, the Association visited Savanac Lake and Lake Placid as the guests of the Savanac members. After breakfast at the St. Regis Hotel, the members visited Dr. Trudeau, an honorary member of the Association, and the Savanac Laboratory adjoining his home. Taking the new state road, the party were conveyed in automobiles to the Adirondack Cottage Sanitarium and the Reception Hospital. The view of the surrounding mountains and the various buildings comprising these institutions was most interesting. The plan of treatment of tuberculosis was fully demonstrated. The party then visited the New York State Sanatorium at

Ray Brook, two miles distant, and enjoyed a luncheon at the Lake Placid Club, from which views of Mirror Lake, Lake Placid and Whiteface Mountain (4,872 feet) were obtained. After returning to Savanac Lake Village, the members were taken to the Country Club and Algonquin Hotel, from which was obtained an enchanting view of Lower Savanac Lake. The members then returned to Dr. H. M. Kinghorn's residence, where tea was served, and then

Lake Placid looking south. Mount Marcy, Mount Colden, and Mount McIntire in the distance. X Dr. Alton's Camp, "Undercliff."

took the private Pullman car which had been engaged to take the party from New York to Montreal.

On June 15, the Association accepted the invitation of the Laurentian Sanatorium Association to attend the opening exercises of the new sanatorium for tuberculosis at St. Agathe des Monts. After an address by the President, Mr. D. Lorne McGibbon, addresses were made by Dr. H. M. Kinghorn, Dr. E. R. Baldwin, and Dr. E. O. Otis.

GUY HINSDALE, *Secretary*.

MEMORIAL.

JAMES B. WALKER, M.D., Ph.D.

We are all saddened, for James Baynes Walker is no more. The loss by death of our useful and congenial member and friend, Dr. Walker, is a sad blow to the members of the American Climatological Association. He was born in Whitpain, near Valley Forge, Montgomery County, Pennsylvania, in 1846. His early years were spent on the farm where he was born. In 1862 he was graduated from the Friends' Central High School in Philadelphia, and he entered the Medical Department of the University of Pennsylvania and received his medical degree in 1872, and the next year he was elected interne in the Philadelphia General Hospital (Blockley), where he served with satisfaction and ability. In 1874, after the required study, he presented a thesis and successfully passed an examination, and received the degree of Doctor of Philosophy from the University of Pennsylvania.

In 1880 he was elected visiting physician to the Philadelphia General Hospital, where he served for many years. He was appointed Professor of Practice in the Women's Medical College of Pennsylvania. The above showing indicates that where he was best known he was the most honoured.

Among his most important connections may be mentioned Capitular Masonry, and he was a founder, being one of the original members of the 1st Chapter of the Alpha Mu Pi Omega Medical Fraternity, and a past president of the University of Pennsylvania Chapter. As a member of the Union League of Philadelphia he was quite active, and was at the time of his death president of the Medical Club of Philadelphia, and an ex-president of the Philadelphia County Medical Society. He was a Fellow of the American Academy of Medicine, College of Physicians of Philadelphia,

JAMES BAYNES WALKER, M.D., Ph.D.

Born December 14, 1846. Died October 19, 1910.

President, 1896.

and a member of the State Board of Medical Examiners of Pennsylvania, a position that he held at the time of his death. He had been president of the Northern Medical Society of Philadelphia, and was consulting physician to the West Philadelphia Hospital for Women, as well as consultant to the Women's Medical College Hospital, Philadelphia. At the time of his death he was the honoured and interested president of the Mutual Aid Association of the Philadelphia County Medical Society, a beneficial organization with a fund of thirty-one thousand dollars, the income from which is used for benevolence to needy physicians or their families in Philadelphia and vicinity.

When the American Climatological Association first met in May, 1884, in the City of Washington, to organize this society, of the new officers then elected but two remain alive—Drs. J. H. Tyndale and Beverley Robinson (Dr. Tyndale was the man who first conceived the idea of the American Climatological Association and who brought about the meeting). The other officers—Drs. A. L. Loomis, Knight, Geddings, Donaldson, Bruen, Hudson, and Walker—have gone to meet the "great majority." Dr. Walker was elected the first secretary and treasurer of our Association, and held the position for ten years to the satisfaction of all concerned. He was a faithful and useful member, having attended all twenty-eight meetings of the Association with the exception of three, and on our index I find he contributed to our *Proceedings* twenty-two times by paper and discussion. Dr. Walker was always a firm friend and strong worker for the good of the Society. He was one of five members who stood by the organization and saved it when its life was threatened in 1886 by members who had more love for medical politics and power than for the American Climatological Association.

Our dear friend Walker was always buoyant, upright, and faithful. He was efficient, being a "host" when he entered upon an enterprise that he felt was important, and never stopped until the work was accomplished. His quick wit and keen perception, which were associated with good judgment, made him a valuable man in all walks of life, an agreeable companion, and an excellent doctor.

I wish I could give to you an eulogy that was fitting

for the occasion, portraying all the good qualities of our deceased brother, but you knew him and recognized his worth. It was my pleasure to be closely associated with Dr. Walker during his life, and sadly I now feel the loss of "dear old Walker."

I present this weak tribute to our dear departed friend in remembrance that his forceful influence and his virile will-power, which he stamped upon the paths he trod in life, will still be an inspiration to us who are left. We will grieve at the severe loss we have sustained in his death, and let us who have been spared take heart and carry on his work and that of his loyal associates who laboured with him in the past. "*Peace to his ashes.*"

ROLAND G. CURTIN.

AGRIPPA NELSON BELL, M.D.

AGRIPPA NELSON BELL, M.D., was elected a member of this Association in 1885, and was later elected an honorary member. He was graduated from Jefferson Medical College in 1842; founder of *The Sanitarian* in 1873 and its editor until 1904; a member of the American Public Health Association; Climatological Association; Honorary President of the International Congress of Tuberculosis in 1904; passed Assistant Surgeon U.S. Navy from 1847 to 1855 with service during the Mexican War; a medical officer of the Navy during the Civil War; Superintendent of the Floating Hospital for Yellow Fever Patients, New York City, 1861; from 1870 to 1875 Inspector for Quarantines for the National Board of Health; a member of the National Quarantine Convention from 1857 to 1860; Commissioner of Quarantine of New York from 1870 to 1873; for twenty-one years Visiting Physician to the Brooklyn Hospital; died at his home in Brooklyn, October 15, 1911, from senile debility, aged 91.

WALTER WYMAN, M.D., LL.D.

Dr. Wyman was elected a member of the American Climatological Association in 1901. He was Surgeon-General of the Public Health and Marine Hospital Service; born in St. Louis, Mo., August 17, 1848; son of Edward and Elizabeth (Hadley) Wyman. He was graduated from the City University of St. Louis, 1866, Amherst College, A.B., 1870 (A.M., 1889), St. Louis Medical College, M.D., 1873, and received the honorary LL.D. degree from the Western University of Pennsylvania, 1897, and University of Maryland, 1907, LL.D. from Amherst College, 1911. He was Assistant Physician in St. Louis Hospitals, 1873-1875, Surgeon in the Marine Hospital Service, 1876-1891, in charge successively of the Marine Hospitals in St. Louis, Cincinnati, Baltimore and New York, and of the Quarantine and Purveying Divisions at the Marine Hospital Bureau in Washington; was Supervising Surgeon-General, Marine Hospital Service, 1891-1902, and since 1902 had been Surgeon-General of the Public Health and Marine Hospital Service. He administered the quarantine laws and establishments in the Continental United States, Alaska, Porto Rico, Hawaii and the Philippines; and had officers stationed in many foreign ports to enforce there the Treasury quarantine regulations. He had charge of twenty-two Marine Hospitals and 120 other relief stations, giving relief to more than 55,000 sailors of the American merchant marine, annually; had charge of the medical examination of immigrants, and prepared regulations for the same. He had been instrumental in the passage by Congress of seventeen laws now on the statute books, among which are national laws relating to quarantine; proper provision for quarters and food for seamen; governmental inspection of establishments manufacturing vaccine, serums, toxins, &c.; for the investigation of leprosy, and the establishment of a Leprosy Investigation Station on the Island of Molokai, Hawaii; the building at Washington of a Hygiene Laboratory; and for the establishment of a Bureau of Public Health, bringing the Public Health and Marine Hospital Service into close affiliation with the scientific laboratories of the country, and with the State Boards of Health, in matters of hygiene and sanitation. Surgeon-General Wyman gave special attention

to the physical conditions affecting seamen of the merchant marine, and was instrumental in having laws passed for their benefit, notably one for the relief of deck-hands on western rivers, and brought to notice cruelties imposed on crews of oyster vessels in Chesapeake Bay, and established a hospital for the latter. He originated and established the Sanatorium for Consumptive Sailors at Fort Stanton, N. Mex.; and while surgeon in charge of the New York Marine Hospital, in 1885, established, with consent of the then surgeon-general, a hygienic laboratory at that station, which was later removed to Washington, and declared by Congress to be for the investigation of infectious and contagious diseases and matters relating to the public health. He established and was chairman of the Yellow Fever Institute of the Public Health and Marine Hospital Service. He had charge of the Government measures to ward off cholera in 1893, and to suppress epidemics of yellow fever in Brunswick, 1893, New Orleans, 1897-1898 and 1905, of small-pox in Birmingham, Ala., 1897, and plague in San Francisco, 1900-1901 and 1907-1908. Surgeon-General Wyman was interested in international sanitation of cities, especially seaports, with a view to rendering rigid quarantine unnecessary, and was author of a plan for an international agreement by the republics of the Western Hemisphere to bring this about. Through influence upon the Conference of American States held in Mexico in 1901, and resolutions passed by that Conference he was largely instrumental in bringing about the International Sanitary Conventions of American Republics, of which three have been held, and over the first two of which he presided, and at the second of these Conventions, held in Washington, he was largely instrumental in framing a treaty relating to quarantine management of cholera, plague and yellow fever, which treaty has been officially confirmed by practically all the American republics; he was chairman of the International Sanitary Bureau of the American Republics. Dr. Wyman was the author of ninety or more articles on public health and sanitation, including scientific treatises on the bubonic plague and yellow fever, and text-book articles on quarantine. He received the Mary Kingsley medal from the Liverpool School of Tropical Medicine, 1910. In the Ninth International Medical Congress, Washington,

WALTER WYMAN, M.D., LL.D.

Born August 17, 1848. Died November 20, 1911.

1887, he was secretary of the Section on Public and International Hygiene; chairman Committee on International Quarantine, Pan-American Medical Congress, Mexico, 1896; chairman of Section on Public Health, International Congress of Arts and Sciences, St. Louis, 1904; president Section of State and Municipal Control, International Congress on Tuberculosis, Washington, 1908; chairman Section on Health, Southern Commercial Congress, Atlanta, Ga., March, 1910. He was a member of the American Public Health Association (president 1902-1903), Association of Military Surgeons (president, 1904-1905), American Medical Association (first vice-president, 1905-1906), American National Red Cross (vice-president and acting president, 1904), and member of Board of Consultation; member of Board of Visitors of the Government Hospital for Insane, and of the Medical Board of Providence Hospital; director of National Association for the Study and Prevention of Tuberculosis, and of the National Association for Mental Hygiene; honorary member of the Imperial Society of Medicine of Constantinople; honorary Fellow of the American Association of Obstetricians and Gynæcologists; member of the American Academy of Medicine, American Medical Editors' Association, elected president of American Medical Editors' Association, Los Angeles, June, 1911, American Association for the Advancement of Science, American Academy of Political and Social Science, National Geographic Society, Society for Psychical Research, American Society of Tropical Medicine, District of Columbia Medical Society, District of Columbia Medical and Surgical Society, Washington Academy of Sciences and Columbia Historical Society. Dr. Wyman was also a member of the Society of Colonial Wars in the District of Columbia (governor, 1894-1895), District of Columbia Society of Sons of the Revolution (president 1899-1900), Alpha Delta Phi fraternity and president of the Washington Graduate Chapter, 1910-1911, and the Metropolitan, Cosmos, University, and Chevy Chase Clubs of Washington. Dr. Wyman died in Washington, November 20, 1911, of Bright's disease and diabetes, complicated by carbuncle.

JOHN ARCHIBALD WILDER, M.D.

Dr. Wilder was elected a member of this Association in 1904. He was graduated from Albany Medical College in 1895, and was for two years an assistant at the Adirondack Cottage Sanitarium. He removed to Denver, and practised there, finally dying of tuberculosis at his home in Hoosick Falls, New York, after an illness of fifteen years, on September 14, 1911, in his forty-first year. He was a member of the Colorado State Medical Society and the National Association for the Study and Prevention of Tuberculosis. He was professor of pathology in the University of Denver, and pathologist to St. Luke's and St. Joseph's Hospitals. He was most highly regarded by all who knew him.

CONSTITUTION AND BYE-LAWS.

CONSTITUTION.

Article I.—Name.

This Society shall be known as the American Climatological Association.

Article II.—Object.

The object of this Association shall be the study of *Climatology and Hydrology and of Diseases of the Respiratory and Circulatory Organs.*

Article III.—Membership.

Section 1.—This Association shall consist of *active, corresponding,* and *honorary* members, the former not to exceed 150 and the latter not to exceed twenty (20).

Section 2.—Names of candidates for active membership, whose applications shall have been indorsed by *three* (3) active members, shall be sent to the Secretary at or before the annual meeting at the second business session of which they shall be read and then lie over until the next annual meeting, when such as are approved by the Council shall be balloted on. Three (3) black balls shall be sufficient to reject a candidate. The Council shall have power to nominate active members.

Section 3.—The power of nominating honorary and corresponding members shall be vested in the Council. The election shall be conducted in the same manner as that for active members. Honorary members shall enjoy all the privileges, but shall not be allowed to hold any office or cast any vote.

Section 4.—Any member of the Association absent from the meetings, in person or by contributed paper, for three (3) consecutive years, without sufficient cause, shall be dropped from the list of members by vote of the Council.

Article IV.—Officers.

Section 1.—The officers of this Association shall consist of a *President,* two *Vice-Presidents,* a *Secretary and Treasurer,* who, with five other members, shall constitute the *Council* of the Association.

Section 2.—*Nominations.* The officers, including the Council, shall be nominated by a committee of five (5) members, which committee shall be nominated by the President at the first session of each annual meeting and shall report at the business meeting.

Section 3.—*Elections.* The election of officers shall take place at the business meeting. A majority of votes cast shall constitute an election.

Section 4.—The President, Vice-Presidents, Secretary and Treasurer shall enter upon their duties at the close of the annual meeting at which they are elected, and shall hold office until the close of the next annual meeting, or until their successors are elected.

Section 5.—Members of the Council, other than the President, Vice-Presidents, Secretary and Treasurer, shall hold office for five (5) years.

Section 6.—*Vacancies.* Any vacancy occurring among the officers of the Association during the year may be filled by the Council.

Article V.—Duties of Officers.

President and Vice-Presidents.

The President and Vice-Presidents shall discharge the duties usually devolving upon such officers. The President shall be *ex-officio* Chairman of the Council.

Secretary and Treasurer.

As Secretary, he shall attend and keep a record of all the meetings of the Association and of the Council, of which latter he shall be *ex-officio* Clerk. At each annual meeting he shall announce the names of all who have ceased to be members since the last report. He shall superintend the publication of the Transactions, under the direction of the Council. He shall notify candidates of their election to membership. He shall send a preliminary notification of the annual meeting two (2) months previous thereto, and the programme for the annual meeting at least two (2) weeks previous to its assembly, to all the members of the Association. He shall also send notification of the meetings of the Council to the members thereof. At each annual meeting of the Association he shall read the minutes of the previous meeting and of all the meetings of the Council that have been held during the current year.

As Treasurer, he shall receive all moneys due, and pay all

debts therewith. He shall render an account thereof at the annual meeting, at which time an auditing committee shall be appointed to report.

Article VI.—Council.

The Council shall meet as often as the interests of the Association may require.

Four (4) members shall constitute a quorum.

It shall have the management of the affairs of the Association, subject to the action of the Association at its annual meetings.

It shall consider the claims of candidates recommended to it for admission to membership.

It shall not have the power to make the Association liable for any debts exceeding in total one hundred dollars ($100), in the course of any one year, unless specially authorised by a vote of the Association.

It shall have the entire control of the publications of the Association, with the power to reject such papers or discussions as it may deem best.

It shall have power to nominate active members at the annual meeting.

The Council shall have power to invite any gentleman, not a member, to read a paper at the annual meeting, on any subject within the scope of the objects of this Association.

The Council shall determine questions by vote, or—if demanded—by ballot, the President having a casting vote.

The Council shall constitute a Board of Trial for all offences against the Constitution and Bye-laws, or for unbecoming conduct, and shall have the sole power of moving the expulsion of any member.

The President, or any two members, may call a meeting, notice of which will be transmitted to every member two (2) weeks previous to the meeting.

Article VII.—Papers.

Section 1.—The titles of all papers to be read at any annual meeting shall be forwarded to the Secretary not later than one (1) month before the first day of the meeting, in order to appear on the printed programme.

Section 2.—No paper shall be read before the Association which has already been printed or been read before another body.

Article VIII.—Quorum.

A quorum for business purposes shall be ten (10) members

Article IX.—Amendments.

This Constitution may be amended by a four-fifths ($\frac{4}{5}$) vote of all the members present at an annual meeting, provided that notice of the proposed amendment has been printed in the notification of the meeting at which the vote is to be taken.

BYE-LAWS.

(1) Meetings of the Association shall be held annually.

(2) The time and place of the meetings shall be determined by the Council.

(3) The dues of active members shall consist of an annual assessment not to exceed seven and a half ($7.50) dollars. Members in arrears shall not be entitled to vote. Those in arrears for two (2) years may be dropped from membership by recommendation of the Council.

(4) Order of business meeting.

First day :—

Calling the roll of members.
Minutes of previous meeting.
Secretary's and Treasurer's reports.
Appointment of auditing committee.
Appointment of nominating committee.
Report of Council on recommendations for membership.

Second day, Morning session :—

Reports of nominating committee and auditing committee
Election of officers.
Election of members.
Report of committee on health resorts.
Miscellaneous business.
Adjournment of business meeting.

PRESIDENT'S ADDRESS.

By JOHN WINTERS BRANNAN, M.D.
NEW YORK CITY.

Gentlemen,—In opening the twenty-eighth annual meeting of the American Climatological Association, I desire to express my high appreciation of the honour you have conferred upon me in calling me to the Presidency this year. To preside over the deliberations of this body is at all times an honour and a privilege. But this is no ordinary year. For the first time in the history of the Society we have come together outside of the boundaries of the United States. What led the Council to choose Montreal for the meeting this year I do not know, but you will all agree with me that the choice was most felicitous, and gives to our gathering a distinction all its own. Were I to breathe my suspicions I should say that our good friend and fellow-member, Dr. Blackader, had a hand and a voice in it. However that may be, we certainly see his master hand in the admirable arrangements for our comfort and entertainment, and I beg to make grateful acknowledgment in the name of the Association.

It gives me pleasure also to welcome the members of the Canadian medical profession who have honoured us with their presence, and I trust that they will take a large part in our proceedings and thus enhance their value. It is a matter of regret that we have so few Canadians in our membership, and I hope that one happy result of this meeting will be a large increase in the representation from the various provinces of the Dominion.

As I look at the programme arranged for us by our Secretary, with the many papers covering a wide range of subjects, but all within the limits prescribed by our constitution, I am inclined to continue my optimistic note and congratulate the members of the Society upon the prospect that lies before them.

At one time it was feared that the meetings of the Association for the Study and Prevention of Tuberculosis at Denver, and of the American Medical Association at Los Angeles, taking place at a date so near to our own, would draw our members westward, and that our programme and our attendance would both suffer. But our fears have proved unwarranted in both particulars, the ties cemented by twenty-eight years of scientific work and of friendship have held fast, and this meeting bids fair to equal the high standard set by those of preceding years.

At our meeting last year in Washington Dr. Hinsdale's interesting paper on the recent floods in France gave rise to an animated discussion on the influence of forests in regulating the flow of rivers. The opinions expressed were so divergent that it was suggested that at our meeting this year there should be a symposium on the relation of forest growth to the increase or diminution of floods. This suggestion has found favour, and a number of gentlemen from different sections of Canada and the United States are here ready to discuss the subject of forestry in all its bearings. I had expected myself to deal rather at length with certain phases of the questions at issue, but there are so many present better qualified than I to speak with authority that I shall content myself with indicating what seem to me the chief points calling for discussion and elucidation. I may also venture to express one or two conclusions of my own.

The general climatic influences of forests, which are of

such interest and importance, I shall leave to other speakers. I shall discuss only the relation of forest growth to neighbouring watercourses, and the effects of deforestation upon the regularity of their flow.

Until quite recent years there seemed to be general agreement that forests control the flow of streams, and that the extensive cutting away of the forests has increased the frequency and height of floods and has intensified the periods of drought. This view was held not only by the general public, who made no pretensions to scientific knowledge, but also had the support of engineers and meteorologists, as well as of the foresters. But now we are informed by some writers that there has been no increase of floods, and that there is no statistical evidence to prove that the forests have any material effect upon either the high or the low water of rivers. There are even high authorities who formerly supported the prevailing opinion who tell us that they have changed their views in the light of further study of the records and of the incidents of history.

During the past few months I have made some study of the documents and arguments submitted by the two parties to the controversy, and I find that it is a situation in which indeed "experience is fallacious and judgment difficult." On the one hand, it is asserted by the foresters that floods are steadily on the increase in the rivers of North America and of Europe, and that this increasing flood frequency is the consequence of deforestation on the watersheds and in the basins of these rivers. This assertion is apparently supported by measurements made by competent observers at various gauge stations on the rivers in question. It is therefore urged by the foresters that the cutting away of the forests about the headwaters of the rivers should cease, and that an attempt should be made to reforest the areas that have already been denuded.

On the other hand, the engineers and meteorologists who have adopted the modern views assert that the figures presented by the foresters are misleading, and in support of their statements offer other observations made upon the same rivers at the same stations to prove that floods are neither more frequent nor more severe than in former times. Consequently, there being no change in the flow of the rivers, deforestation can have had no such injurious effects as we had been taught to attribute to it. Further, it is claimed that all forested land which has been converted into agricultural land has been put to its best use, and that no land which is suitable for the growing of crops to provide food for the people should be withheld for the growing of timber. It is of interest to note that this last view is shared by many even of those who believe that forests are an important agency in regulating the flow of streams and surface water.

I shall not attempt to reconcile the apparently conflicting data offered by the foresters on the one hand and by the engineers on the other. It is probably not possible to bring them into agreement, and I do not believe that it is necessary for our purpose. To show the difficulties of the situation let me refer briefly to two publications, one by the French engineer Belgrand, quoted by Dr. Hinsdale in his paper; the other by Pierre Buffault, also a Frenchman. Belgrand, as you may remember, had daily measurements made for nearly three years of the flow of two rivers, the Cousin and the Grenetierre. The basins of these streams are of granite formation, impermeable and otherwise alike, but the first is only one-third wooded, while the second is entirely covered with trees. Notwithstanding this great difference in the extent of forests in each, the results were the same in both. Their waters rise and fall at the same rate, whether in rainy weather or in dry, in winter or in summer. A heavy rain

in winter produces in both a sudden flow of greater or less height, but of very short duration, followed by a long stage of tolerably high water; the sudden and high freshets take place in each at the same time. The flow of water is therefore exactly the same in both, though one is covered with forests, while in the other two-thirds is bare of trees. Belgrand has made other observations which show, further, that the greatest regularity of flowage is observed not upon forested but upon cultivated ground.

Buffault's paper appeared in January of this year, being published in the *Bulletin of the Society of Commercial Geography of Bordeaux*, and is entitled "Two Instances of the Influence of Forests upon Floods." It describes observations made in May of last year during the flood season upon two rivers in south-western France, La Rivière d'Isle and La Gélise. The Rivière d'Isle receives tributaries from the right bank which come from a wooded region (45 per cent. forest), whereas the affluents from the left bank are from less wooded hills (25 per cent. forest). The rise of water from the first streams was very moderate, and caused no damage, while that from the second group was very violent, causing great damage to the banks. Yet the reverse should have taken place, as the soil in the region of the affluents of the right bank is of impermeable clay, but of porous lime formation in the basin of those of the other side of the river. The second instance is even more striking. The Gélise receives, from the left, streams from the country of the Landes, where the subsoil (of clay) is little permeable, but largely in forest (73 per cent.); from the right, streams from regions under high cultivation, but entirely deforested (3 per cent. only forest), but with subsoil of permeable calcareous formation. The Gélise itself comes from a region without forest. The Gélise and its tributaries from the right

rose enormously, causing a large amount of damage, but the streams from the left rose very little, except in the lower part of their course, because of the backing up of the swollen Gélise. In these two instances cited by Buffault, in which the weather conditions were the same, the affluent streams in each case being in close proximity to each other—one and the other side of the same valley—the advantage was largely with the wooded basins, in spite of the opposing influence of the subsoil.

These contradictory reports of Belgrand and Buffault can be duplicated many times in the literature of the past few years, and probably also in the experience of many of the gentlemen present in this gathering. Without attempting to explain or to harmonize the conflicting nature of these and other observations, and also without questioning the good faith and accuracy of those who have made them, let us see if we cannot find some ground to which all reasonable men may repair. A week ago I found myself apparently hopelessly confused by the claims and statements of the two sides, but since then I think that I have seen a new light, and I shall venture to present a few conclusions for your consideration.

The forest floor surely protects the springs and controls the surface flow of water better than ground that has been denuded of its natural cover, especially if it lies upon a hill or mountainside. If, however, the ground is fairly level and is suitable for agriculture and is under constant cultivation, the growing crops form not a bad substitute for the forest. We must agree with Raphael Zon, who writes in "American Conservation," that "the fundametal principle upon which a wise national land policy should rest is that every acre of land should be put to the use under which it will bring the highest returns." Zon also believes that it is

the duty of the Government in any country to help the people to put the various classes of land to their best use by surveying and classifying them upon the basis of their soil and climatic conditions. By so doing we should bring about, in his language, the most productive use of our greatest resource—the land itself. I do not think that we can expect to reforest level or slightly rolling land which is now under cultivation, nor should I consider it desirable to do so. I believe also that practically all forested land which will serve for growing food crops will eventually be cleared for that purpose.

In the mountain ranges, on the other hand, and upon steep hillsides, the forests should be preserved, not only to ensure a regular supply of water for our great river systems, but also to prevent the danger of excessive erosion. The damage caused by erosion in the valleys of deforested mountain districts is well described by Bruncken in his book, "North American Forests and Forestry," to which I would refer you for an admirable discussion of this whole question. Similar considerations call for the preservation of the forests in the mountain ranges of the Far West, where, because of the slight rainfall, agriculture is dependent upon artificial irrigation, the water for the canals being derived mainly from the snow in the mountains.

Finally, the forests which are reserved by either State or national government should be managed on modern scientific principles, so as to increase their productiveness and improve their condition. They will thus become more valuable as a source of timber, and also as a protective cover for the watercourses.

THE CLIMATIC AND HYGIENIC INFLUENCES OF FOREST GROWTH.

By JAMES M. ANDERS, M.D., LL.D.

PHILADELPHIA, PA.

It is unreasonable to affirm, as some earlier writers have done, that desolation awaits the greater portion of the territory of the United States, on account of reckless denudation of the forests, and also that man's destructiveness and wastefulness of the national resources will only terminate with the direst unsought results to our civilization. Primitive man could not have found room for expansion without the preliminary removal of a portion of the forest growth, but there is clear and convincing historic evidence that wanton and thoughtless destruction of woods has too generally obtained in the past.

For the prevention of the evils of future unwarranted deforestation in this country, we must look to the diffusion of greater knowledge on the subject, and to the enlightened self-interest for which the American people are truly remarkable, and not trust to either State or national government alone, since these move with too slow a pace, as a rule. It would seem fitting, therefore, that this Association should concern itself with those aspects of the question of forestry which bear more or less close relationship to meteorology, hygiene, and sanitary science. It is also clear that men of science, who by virtue of their training are peculiarly equipped to investigate the subject of the meteorologic effects of the woodland, owe a debt in this respect to the general public, to others, yet it must be admitted that meteorologists

have given less attention to this question in the past than it merits.

All progressive civilized nations aim to maintain and perfect an efficient system of forestry. While the United States has only recently begun to create a forest service, interest in the general subject is increasing at home, so that the present would appear to be an opportune season for making a brief survey of certain of its aspects which possess more or less professional interest and importance.

The diverse relations of forest growth to states of climate and the soil embrace numerous elements, many of which are not only complicating, but also really conflicting; hence has arisen considerable divergence of opinion among the foremost authorities. Fortunately, the birth of forestry as a science has finally been witnessed in this country, and important advances, the result of serious study, may be reasonably expected in the future.

Formerly the conclusion of physicists respecting the meteorological influence of forests were in a great degree inferential, hence the conclusions reached by different writers were quite inharmonious. As Pinchot* pertinently remarks, it is a matter which is easily written and talked about without any thorough understanding of forestry itself. We are just beginning to approach the study of the question of the effect which forests exert upon climate in a proper manner, so as to give a clear conception, not only of the degree of their influence, but also the distance to which that influence reaches. It has been found that certain traditions concerning the influence exerted by forests upon climate have been fully confirmed by the results of recent scientific investigations, while others have been definitely shown to be unfounded.

* "Practical Forestry," Part II., 1909.

Within the past two decades some knowledge has been gained by experiment or direct observation, and, as the natural outcome of this work, the balance of opinion at present writing favours the assumption that forests possess certain climatic effects of considerable practical significance. Unquestionably, the subject of the connection between forests and climate will require long and careful experiments and observations before a satisfactory solution shall have been reached.

It will be convenient to take up the various ways in which forests influence climatic factors *seriatim* :—

(1) Forests Oppose Resistance to the Free Passage of Wind-currents and Moderate the Extremes of Temperature.

Evidently trees are well adapted to check the movement of the air, since both branches and leaves, particularly in the case of bushy tree-tops, act as efficient barriers. The particles of air not checked by the first row of trees to the windward would have their force diminished, and be promptly checked by the trees to the rear. Those of us who live in the Eastern States little realize to what extent wind-breaks have been planted by farmers in the western part of our country to protect their crops and homes against the wind. In this manner considerable masses or even belts of trees, "by intercepting strong wind-currents, not only afford shelter to man, the crops, and humbler vegetation generally to the leeward, from the chilly blasts of winter, but also the drying winds of summer, thus having the effect to modify extremes of temperature, rendering summer less sultry and winter less severe."*

The ameliorating influence of forests on the chilly spring

* "House Plants as Sanitary Agents," p. 278.

and autumn winds is highly important to the agriculturist. It is well known that certain crops are slow in maturing, as in regions in which bleak winds prevail in unwooded districts, and it is undeniably true that, given similar soils, fruit grown in the city surpasses in quality and size that grown in the country—"a fact ascribable to the more effectual shelter in the former than in the latter locality."

During the warm season the air of the woodland is cooler than that outside. This fact is fully confirmed by the observations made abroad, more particularly in Bavaria and Wurtemburg, where it was shown that the highest temperature of every day in the year was lower by nearly 4° F. on the average, while the lowest temperature was higher by 2° F. in the forest.

Says Pinchot*: "Prussian observations showed that for ten years the greatest heat of the day in July was, on an average, nearly 6° lower in the forest, and the greatest cold of the night in January nearly 3° less than outside." It is easily demonstrable that the air of the forest contains a somewhat higher standard of average humidity than that outside, and any increase in the amount of moisture in the air reduces the temperature, though the fall is not always proportional. M. Woeikoff† has called attention to the depressing effect of moisture upon the temperature, giving convincing illustrations from Western Europe and Asia.

This influence may upon further investigation be found to be greater in the United States than the observations cited indicate in our country at least, on account of the total absence of forests over immense areas of country, and the extreme variability both as to temperature and humidity of our climate. It should be noted in passing that this action

* *Loc. cit.*

† Peterman's "Mittheilungen," *Pop. Science Mo.*, January, 1886, pp. 428-430.

of forests upon the temperature is facilitated in a mechanical manner. The screen formed by the branches and foliar organs to a marked degree intercept the solar rays, producing shade which has a delightful cooling effect by day, while it lessens the radiation of heat at night. The air coextensive with the shade being cooler than in the sun, these differences of temperature cause a slight motion in the air or draught. Von Pettenkofer's dictum, therefore, that shade in the open air always causes a slight draught, which acts as a kind of fan, is doubtless a correct one, and is due to differences in gravity of layers of air of unequal temperature.

Two additional ways in which forests affect the temperature of the air remain to be mentioned—first, the air is cooled by transpiration or the evaporation of water from the leaves; and, secondly, the air below the covering formed by the forest leaves is kept cool in consequence of its absorption of the heat. The effect of the cooler air extends for some distance without the forest, since the falling colder air "flows off along the surface into the open country and causes local breezes" (Pinchot), while it is being replaced by a rising current of warmer air. It is well understood that these currents are reversed during the cold season, hence the forest is now warmer than the air at a distance. The opinion, therefore, that forests are natural equalizers of the temperature rests upon exact scientific premisses.

(2) Forests Influence the Atmospheric Humidity in Their Vicinity.

The effect exercised by growing forests upon the humidity of the surrounding air can justly claim a large share of importance. The explanation of the influence of the woodland upon atmospheric humidity includes certain well-known mechanical influences. In the first place, the vegetable

canopy prevents, in a measure at least, the rays of the sun from reaching the earth and warming it, so as to facilitate evaporation from the soil. Again, forests, forming as they do a more or less perfect screen interposed between sky and earth, intercept to some extent the dews and lighter rains, "which are at once returned to the atmosphere by evaporation, a small portion of this moisture only reaching the earth." Ebermayer carefully computed evaporation from the soil of the forests as rather more than one-third as great as from the open soil. The amount of moisture arising from the soil of the forests is also potently influenced by the presence or absence of leaf mould.

Ebermayer found as the result of experimental observation that evaporation from forest soil without a layer of mould was 47 per cent. of that from soil in the open, while with a layer of mould it was less than half as much, or 22 per cent. These facts have been advanced as powerful reasons for preserving mountain forests at the headwaters of streams, more particularly in mountainous districts, since it has been definitely shown that the effect of the forests in preventing evaporation becomes greater with increasing altitude.

My own experiments, with the view to determining the amount of aqueous vapour evaporated from known areas of leaf-surface and land-surface, under similar conditions for the sake of comparison, gave the uniform result that the evaporation from the former is greatly in excess of mere surface-evaporation. From facts of observation, it is reasonably certain that transpiration is one of the principal factors in connection with the influence exerted by forests upon atmospheric humidity.

While a leading effect of wooded districts is to preserve the moisture of the soil without favouring excessive humidity of the superficial strata by impeding evaporation from their

soil, the trees are always supplied with an abundance of moisture for transpiration, owing to the power which they have to attract moisture from every direction as well as to retain the rainfall in their network of smaller rootlets, to be in due season absorbed by the myriads of root hairs. Much of the moisture drunk up by the roots of trees is returned to the atmosphere by the process of transpiration, which is practically uniform during clear, warm weather. For example, experiments long since conducted by the writer showed that "more than one and a quarter ounces of watery vapour per square foot of leaf-surface for twelve diurnal hours" was lost by the average tree.

On comparing the mean transpiration from one square foot of leaf-surface with an equal area of soil under like circumstances of exposure, it was found that the result obtained was 6 to 1 in favour of the latter. If it were definitely known how many times greater the leaf-surface of a forest is than the land on which it is situated, it might with ease be computed what is the relative evaporation-rate from a forest as compared with an equal area of open country.

From certain personal observations it is safe to assume that the leaf-surface of a wooded district is, as a rule, more than six times greater than that of the ground on which it stands; hence it follows that transpiration from the forests must exceed the evaporation from that of an equal area of open soil. It was also shown experimentally that the humbler specimens of vegetation exercise an effect in the same direction. It would seem to me to be entirely warrantable to draw the *a priori* conclusion that wherever a fair proportion of woodland exists, properly distributed, a considerable influence must be exerted thereby upon the hydrometeorology of the region.

On the other hand, during the cold season, forest vegeta-

tion obviously distills into the atmosphere little or no moisture, but their deeper underlying root-terminals, after a sponge-like fashion, hold considerable moisture in the soil, hence the earth in their vicinity is more humid than elsewhere in winter.

In view of the foregoing facts, it is also clear that if the forest air be cooler, its relative humidity must be greater than that of the air outside. It has been shown by actual observation that the average humidity of the forest air is from 3 to 10 per cent. greater than that of the outer air. These differences are exaggerated with the altitude above the sea level and the density of the forest vegetation.

It is not pretended to claim that the increased humidity of the forest air as compared with that of the air at a distance is due alone to the function of transpiration, but this difference is also accounted for, in part at least, in other ways previously explained. On the other hand, what is definitely known concerning transpiration with respect to its almost inconceivable rate and uniformity during clear weather throughout the warm season may be restated, as showing that it is a factor not to be omitted from consideration. Moreover, the effects of this function are, for reasons before stated, manifested to a less marked degree within the forest area than upon the immediately surrounding atmosphere.

The question, however, to what distance the influence of the woodland upon the relative humidity of the air extends beyond its own borders is still imperfectly understood. In this connection, Pinchot points out that a system introduced in Austria is expected to give a clearer idea; it consists of lines of stations beginning in the centre of a large forest and extending step by step into the open country beyond.

The physiological function transpiration therefore produces an appreciable effect upon the meteorologic element

humidity, but, more than this, it maintains a more nearly uniform degree of atmospheric moisture than is to be found at a distance. It is not too much to claim that forests are natural equalizers of both temperature and atmospheric humidity.

(3) Forests Produce Ozone.

One of the beneficial effects of forests is attributable to their energy in developing ozone. My own observations, which have been detailed elsewhere, showed that ozone is generated by odorous foliage, and all of the flowering species, more particularly by scented flowers.* According to my researches, the exhalations from the conifera were particularly energetic in the production of ozone—a fact that affords "an opportunity of entering a seasonable plea for the more careful preservation and cultivation of American pines."†

In this connection it is to be recollected that during the winter season forests do not develop any of this substance. This conclusion is measurably confirmed by the results of the careful researches of Nicholson, who found ozone more abundant in pine forests than in the open country in summer, and less abundant in winter. The writer found that the ozone-generating function is to a less degree under the control of the temperature than the action of the direct rays of the sun, so that outdoor vegetation, if we except periods of stormy weather, is constantly active in aiding to maintain the needful supply of atmospheric ozone.

Ozone, through its power to combine chemically with pernicious organic impurities, probably constitutes Nature's principal means of purifying our atmosphere. It was the late Professor Max von Pettenkofer who said: "It is the

* *Loc. cit.*, p. 300.
† *Loc. cit.*, p. 301.

constant purifier of the atmosphere from all organic matters which passes into it and might accumulate. The air would have been long ago filled with the vapours of decomposition if it were not for ozone, which oxidizes all that is oxidizable, if only time be allowed for it, and not too much is expected at once." It is interesting to note the intimate association of certain of the principal plant-functions with the laws of hygiene, or, in other words, to behold important sanitary influences residing in mysterious physiologic functions of living vegetation.

The sanitary influences of forest-growth are principally dependent upon the two physiological functions already discussed—namely, transpiration and ozonification; but these do not extend to any great distance beyond the borders of the woodland, or, in other words, their effects are chiefly local in character; it follows that careful attention should be paid to the distribution and topographic arrangement of our forest-growth.

Without detaining my hearers with a description of special places, the value of forests and particularly pine groves, to the consumptive will be readily conceded. There are no facts to oppose the practice of sending cases of laryngeal tuberculosis to the pine forests, where patients can obtain the superior benefits arising from a highly ozonized and terebinthinated atmosphere, if these resorts afford ordinary home comforts.

In view of the known effects of the plant-functions, transpiration and the generation of ozone, there can no longer be any question as to the sanitary importance to a municipality of public squares, provided that they be filled with appropriate growing vegetation. While this subject is not germane to the present discussion, it is desired to point out in passing that city parks, if properly supervised, possess

hygienic advantages apart from their value as mere breathing spaces.

On reviewing briefly the foregoing discussion of the climatic and sanitary relations of forests, we find them thrice illustrious: (*a*) as modifiers of extremes of temperature, particularly the diurnal range, which is of greater sanitary importance than seasonal variations, while at the same time rendering summer less sultry and winter less severe; (*b*) as natural atomizers of aqueous vapours, whereby they tend to maintain an unvarying degree of atmospheric humidity in their vicinity; and (*c*) as natural producers of ozone, which removes the organic impurities from the atmosphere by oxidation.

I have endeavoured in the foregoing discussion to state only well-established facts, and if I have succeeded in so doing, then the few conclusions which I have drawn from them are, it is hoped, logically sound. Lastly, there is a fair prospect that more definite beneficial effects will be attributed to forest-growth as the result of systematic investigations now in progress and in contemplation.

DISCUSSION.

Professor R. F. STUPART (Toronto): Mr. President and Gentlemen of the American Climatological Association,—I wish in the first place to thank you very much for having granted me the privilege of being with you this morning and of giving me the opportunity of hearing the discussions on a subject which to my mind is extremely important. As far as the question of the effect of deforestation and floods is concerned, I must confess that this is a subject to which I have not given the attention it is worthy of. However, I am not wholly wanting, I have done something. Some years ago I undertook an investigation of the relation between the rainfall in the region of the great lakes of North America and the state of the water levels. This investigation led to some quite interesting results, some of which results were published in a paper presented to the Canadian Institute in Toronto. From numerous stations situated near the Great Lakes, six were taken in the

watershed of Lake Ontario, six from Erie, eighteen from Huron and Michigan, and five from Lake Superior, and judging from the whole of these combined there appears to be little, if any, evidence of a diminution of the rainfall. If, however, we take the Toronto record by itself, a record extending back to 1840, there seems to be some indication of a diminution in the annual precipitation; certainly there is good ground for further investigation.

Yesterday I looked up the figures for Montreal from 1863 and I found that in eight years of the sixties the average precipitation was 38 inches; ten years later it was 39.2, then 40.1, 41.4, and 41.7. Clearly there has been no diminution here, but rather an increase.

The Toronto temperature record extends back to 1830, and from this it is fairly evident that the summers in Toronto are nowadays a little warmer than they were in the forties or fifties. In the 1840-49 decade the mean temperature was 64.4, and this has increased until during the last ten years the mean temperature at Toronto has been 66.7, and during this period of over seventy years the instruments have been exposed within a hundred yards of the same spot. Of course, Toronto has increased in population from 25,000 to 400,000 and the Observatory is just on the outskirts of the city, but if the city growth is a factor it should tend toward warmer winters, and this is certainly not the case. We see, then, that the summers have apparently become slightly warmer, and evidence of warmer spring months is still more marked. In the fifties the mean temperature of April and May combined was 47.1, while during the last ten years, in fact the last two decades, it was 50.4. This is certainly strong indication that our springs are not quite as cold as in the earlier years. As regards the winters, the ideas held by the old inhabitants are wholly erroneous. Nearly all the inhabitants will tell you that we have no winters like we had in the early days. But our records show very conclusively that this is not the case; there are indications that our winters in Ontario are slightly colder than seventy years ago. In the forties, and also in the thirties, the mean temperature was 25.5, while in the last ten years it had dropped to 22.1.

There is a very general opinion in the Province of Ontario, and our records bear it out, that there is less liability to summer frosts than formerly, and this is very probably due to the fact that in the early days of settlements, the farms consisted of small clearings of a few acres of land for cultivation in the middle of the forests, where with little wind movement, on cool summer nights, radiation would be excessive.

It would appear then that our meteorological records show that the operations of man have had very little effect on the climate of Canada, though there is something more than a suspicion that the clearing of the forest means a warmer summer and a colder

winter Of course we all know that rainfall is the result of some of the great operations of Nature, the general circulation of the earth's atmosphere, and that the rain falls when a volume of moist air is cooled beyond the dew point, and that this cooling is almost invariably caused by expansion in ascending. We have in British Columbia great rainfalls on the western coast. The moist westerly wind of the general circulation impinging on the western slopes of the mountains is deflected upward and cooled and rainfall occurs. In other parts of Canada the rainfall is almost wholly of cyclonic origin where air is cooled through ascent within the boundary of a cyclonic area.

There is good ground for belief that most of the rain which falls over Canada is formed from moisture which is brought from the Atlantic and Gulf of Mexico, and even if we assume that the deforestation of large areas has some small effect on the precipitation, I am inclined to think that the deforestation of tracts far to the east and south of, say, Ontario, may have a greater effect than have the local conditions.

Another question in connection with deforestation is the heat wave. They are not home-brewed. We get the heat wave in Canada straight from the south. This air is brought northward from the United States into Canada, and the deforestation of the lands to the south may tend to intensify the heat wave.

The question of floods is something that I have really not investigated, but I am inclined to doubt the quite prevalent idea that floods are more disastrous nowadays than when the country was densely wooded. While listening to Dr. Anders' paper I have been wondering whether, as regards floods, forests may not play a more important rôle in a country with a cold winter climate than they do further south. In the provinces of Quebec and Ontario, snow lies in the woods until well on in March or sometimes until mid-April. A heavy spring rain will cause a rapid melting of this snow, and floods are certain to occur in the watercourses. In cleared districts, on the other hand, the snow disappears more rapidly in early spring under much bright sunshine, and floods are likely to be less pronounced. During all other parts of the year the forests tend to equalize the flow of streams.

I thoroughly agree that the forests should be maintained on the mountain slopes, because while they may have no effect on the rainfall, they, there as elsewhere, tend to conserve the moisture during the warmer months. In a recent study of the precipitation in Alberta and on the eastern slopes of the Rocky Mountains, it has been found that rainfall depends chiefly on the distribution of atmospheric pressure and usually occurs with northerly winds, while a cyclonic area is moving across the North-western States.

Dr. J. H. ELLIOTT: I think that Prof. Stupart has covered the

ground, and there is very little more that I can say, as he has all the figures at hand. The question of re-forestation is beginning to play an important part in Canada as well as in the United States, and we are glad to know that in many of the provinces this question is being taken up very seriously. In Ontario the Provincial University has established a department of forestry under the excellent direction of Dean Fernow, who, I believe, had the honour of being the guiding hand in leading your Director on the other side of the line into taking up this question. Mr. Pinchot and Dean Fernow have both been doing most excellent work in increasing general interest in both re-forestation and in conservation of our wooded areas. Dr. Anders' theory, which has been evolved from his observations, that forests do modify the temperature to some extent, seems to be borne out by the data of Prof. Stupart in his Toronto observations, which show that the heat in summer is slightly greater and the cold in winter greater also than it was years ago when large areas of country about Toronto were forest. The very slight degree of difference can be readily accounted for by the influence of the vegetation on temperature.

Floods in spring is a question we discussed last year at Washington. Their occurrence is readily explained if we consider the melting of snow in the springtime to be equal to the rainfall. The snow is lying in the woods, and with the warm spring a great deal of that snow is melted and can be readily compared to a rainfall at that time. I was interested in Prof. Stupart's remarks about the old inhabitants' belief that not only were their winters more severe, but that we did not have as much snow as years ago. Prof. Stupart has shown from actual figures that the snowfall is practically the same as it was fifty or sixty years ago. I hope that there will be further discussion on the subject before us, and that Prof. Stupart will take this question up and make sure that we are getting observations from those forest areas which in future will be deforested, so that in later years we may arrive at definite conclusions regarding the influence of this deforestation upon meteorological data.

Dr. C. L. MINOR: I am interested, as we all are, in this subject, and yet I feel myself practically unable to speak upon it, for there are but very few of us with statistics at our fingers' ends, like Professor Stupart, which are so dear to the heart of Dr. Brown. Human observation is variable, and although we may draw conclusions from longer or shorter experiences during a longer or shorter life, much difference would be found in our conclusions. Still I have, I believe, a right to express my impressions. It is a subject difficult to discuss because the personal interests of so many people are bound up in it; there is so much politics in this question, so much financial interest bound up in it, that to get absolutely an unbiassed expression

is a very difficult matter. We realize how interesting this topic is in the United States, how the Trusts put out their fingers and even get scientific corroboration on the things which bear out their personal interests. I trust it is not so in Canada. Still, this is not a question of whether deforestation affects rainfall, about which I have not an opportunity of forming an opinion, but to me the very important question is as to whether deforestation in the type of country in which I live has a harmful effect upon the flow of our rivers, upon the important water supply of low-lying districts, and whether it develops freshets, wash-outs and abnormally high water in streams. You cannot possibly expect deforestation not to occur in level lands, and Ohio to-day, for example, with its broad green fields of wheat, is a much richer country than when it was forest. But when you live in North Carolina, with mountains ranging up to 7,000 feet, you realize that when those hillsides are stripped they are practically useless for any other purpose, and it is a question if the lumber taken off has a pecuniary value compared with the damage done by cutting off the water supply of the low country. Anybody who has walked through our forests and our rhododendron thickets will realize that they act unquestionably as a reservoir, holding the water in the moss and leaves around their roots. Those who have the misfortune of seeing what the lumbermen are doing now, where a reservation has not been set aside, will see the absolute converse. Here the snow runs off these bare hills, melts rapidly with the rays of the sun, and it would seem to me that we have increased the violence of the harmfulness of our spring freshets, just as deforestation has advanced. The question of the small streams is also a grave one. Formerly they used to run our mills in the Southern States; now they are always dry in summer. So long as America remains the spendthrift of the nations, so long as we only see the immediate good in our hands and have not got the foresight to look forward to the good of future generations, these things are bound to continue. Things look to me very hopeless, and until we start to do again by scientific forestry what we have been undoing, this condition of affairs will not improve.

Dr. WILLIAM H. BERGTOLD: I did not come here prepared to discuss this question; yet, if you will allow me, I would like to touch on a phase of deforestation somewhat remote from climatology. Dr. Minor has said a good many things which apply to that part of the country in which I live—to wit, Colorado. I have been connected with that State more or less for thirty years, and from this residence I see that we now have conditions there similar to those described by Dr. Minor as existing in the South, only more accentuated. Naturally, as you all know, the question of the effects of deforestation is a very complex one; the lesser question of an increase or decrease of floods is also a complex one to decide, and one not to be settled in a few

years only, probably not in several generations. In Colorado and similar parts of the West, so much water is used for irrigation that it is not possible to make comparisons of present river flows with those of the past, a combination—one of many—making it difficult to determine if there be increased flows in our water basins. Hence we may say that, from our position in Colorado, it is hard to say whether we have increased or decreased floods. If one takes the testimony of "old timers" one is inclined to believe that floods are now no worse than forty years ago. The question of denudation from an economic point of view is most important. There are Forest Reserves in the West on which cattle grazing is permitted under reasonable restrictions; on some of these Reserves thousands of cattle thrive, yet at a glance one would think they would starve. In the well-timbered portions the food is abundant, and the soil well retained in place by the forest, while the adjacent denuded areas have but indifferent feed, and the cattle do poorly on it. In this retention of good feed in an undenuded area is partly bound the economic question of our cattle supply, by no means a small thing. Remove the timber, and a loss of soil and feed occurs, and by so much is the grazing cut down, with loss of cattle production, and loss of prosperity. In a word, forest growth, in some sections of the country at least, promotes the cattle industry.

Dr. A. J. RICHER: I am sorry I missed the first part of the discussion and all of the paper. I understand it was relative to forestation and deforestation. It has been noted in the far north, especially in winter, that the vitalizing effect of life in the wilderness as practised among the wood-cutters is something really remarkable. The unfortunate feature, however, is that no thoroughly well-based observations have been made upon the subject. These have been more casual than otherwise, and no invalids have been submitted to that form of life which these wood-cutters follow during the entire winter. To any of us who have had the advantage of visiting a lumber camp in a northern country with the thermometer at 40° F. below zero, or thereabouts, and noticing the extreme comfort under which these people live without any of the added advantages of a household such as in a town, their endurance is marvellous. For instance, I have gone into the woods and have felt almost as though in a warm room—this in the winter time. But the most important point is the vitalizing influence that this form of life brings, and it is unfortunate that invalids have not been submitted to this mode of living, either in winter or summer. It would be interesting if an experiment were carried out, even in a small way, in a fairly comfortable house in the midst of the forest, free from undergrowth and the forest not too young (not under thirty years), as this seems to be the most advantageous as far as casual observations have proved. This vitalizing influence has been noted particularly in the winter

time. It will also be noted that the digestive function seems to be influenced by that form of life, and it is marvellous the power of digestion which is developed under these conditions. One can also stand extreme degrees of cold with comfort, feeling much as one would in midsummer with a temperature of 80 or 85. This is a most important feature of life in the forest, and it certainly does bring some little degree of comfort to think that in a northern climate, especially where we strive constantly to avoid the ill-effects of winds from open spaces. Here I feel there would be some field for good sound observation such as has been aroused by the discussion of this paper.

Dr. J. MADISON TAYLOR (Philadelphia, Pa.): This particular subject is pre-eminently one which this Society should reach to the very heart of, and acquire information both for ourselves and the public at large. In the discussion, so far, it seems we are looking a bit too narrowly at the subject, comparing conditions which are not yet sufficiently developed. If we want to get a proper degree of appreciation, we should go back to conditions which obtained in ancient times and countries, where we know there was a large measure of forestation and which are now all denuded. We should make comparisons now between that time and this, those conditions and now. I have in mind the country of Greece, and in Asia, especially that portion known as the valleys of the Euphrates' and the Tigris, where conditions have changed radically. If we were to look at the subject in that way and get data to offer parallel to present ones, we could get a better idea of the effect of deforestation of tracts of land, and could reach more definite conclusions. I was particularly pleased with Professor Stupart's presentation of the subject and his comprehensive, all-round view; but to my mind it is all being considered from too close at hand and conditions too analogous to our own, and the inferences are that too limited conclusions are reached. Much more can be got from comparing older countries and ancient conditions with our own. Finally, this whole subject is bound up so closely with another vital one of which I think the medical men do not take sufficient note, viz., anthropology. I urgently recommend that this Society take under consideration problems in race development and race betterment, and will myself make a contribution to the subject next meeting, and hope for an enlightening discussion. This has interested me a good deal, and I would merely throw out the observation to show the connection. You can see that the whole development of people, as pointed out by Dr. Richer—their whole actual physical condition—may be dependent upon their surroundings, as instanced by the physical condition of these men in the lumber camps. And so I would point out that the whole question is closely bound up with the expansion of races and anthropology.

Dr. GUY HINSDALE: Dr. Anders has touched on a very interesting point which we as a Society should look into more closely than has

been done: that is the question of ozone. He has referred to the great value of ozone, but I have noticed of late years that there is considerable doubt arising as to its real value or the part it plays in regard to health conditions. What the truth is I do not know, but there seems to be a great deal of doubt about the value of the chemical tests for ozone in the atmosphere, and I should like to suggest that someone take up the subject of the real relationship of ozone to conditions of health, and the most reliable means of estimating it in the atmosphere. I think this is fully within the limits of the Society's scope, and it is something that we really do not know a great deal about—how to measure it, how to recognise it, how it acts. When we remember the minute amount present in the atmosphere which, according to Weber and others, is always less than one in 700,000 parts, we begin to realize the difficulty of properly estimating the effect of ozone on animal and vegetable life.

Dr. GEORGE D. PORTER (Toronto): I appreciate very much the privilege of attending this meeting, and really came to listen and not to discuss any questions. As Dr. Richer has pointed out, the splendid physical state of health, exuberance of spirits and power of endurance of these Canadian woodmen is truly remarkable; there is no class of people to be compared in strength with these men. It is only in an accident or an emergency that a physician is called, seldom for a case of "sickness," though probably these same men, living under village or city conditions, would find it necessary to consult a physician more or less frequently. This subject is very interesting, and it is extremely important to find out the exact relationships of these wooded to non-wooded localities towards general health.

Dr. R. C. PATERSON: There is one thing which strikes me, and that is that in this discussion we must consider not only the influence the trees themselves bear to us, but also the changes which take place in the soil when the trees are removed. Those of you who visit Ste. Agathe will notice hillsides on which the forest growth has been destroyed by fires, and since the trees have been removed these hillsides have been washed absolutely bare of all their soil. It stands to reason that there is a difference between a soil which is absorbent, which can take up moisture and give it off gradually, and a bare rock which absolutely cannot absorb any moisture, and this must have some bearing on climate and the hygienic influences which climate has on the people.

Dr. JOHN H. HUDDLESTON (New York): One question which this discussion brings up, and which is of interest to me, depends upon the fact that of the various sanatoria throughout the country some are distinguished by being placed in comparatively wooded localities and having buildings which are more or less closely surrounded by trees, while others are situated in comparatively denuded areas and have buildings quite removed from any trees. An expression

from those who are most familiar with the work of either of these two classes of sanatoria would give us some information, possibly as to observed effects and certainly as to their own feeling about the desirability of trees close to the buildings.

Dr. ESTES NICHOLS (Portland, Maine): Coming from a forest State, I would speak of one kind of deforestation which has great bearing on floods and climatic conditions, namely, deforestation by fire. Our water supply in Maine comes from the mountains, and there we have seen many very disastrous fires. The soil on the mountains is only a few inches thick and is made up of a sponge of leaf mould and small rootage. When a fire sweeps over these mountains it has destroyed the soil so completely that nothing is left for new growth. After heavy rains, when the ground is frozen, the water, instead of draining off, simply rushes into the rivers and is bound to cause floods and a great deal of damage. When lumbermen deforest a district they leave something behind, but in the case of fire nothing is left, and I feel this Association should lend its support toward the protection of forests from fire. Another point in the climatic influence of these bare mountains—they must make a great difference in the radiation of heat; and as Professor Stupart has said, Canada is subject to heat waves that must come from the States, and we must be subject to cold waves from Canada, and it is not the sort of reciprocity that we like. If Canada does not like our heat waves neither do we like her cold waves, and we think that forests may make a great difference in controlling them. Radiation of heat from these bare mountains must make a considerable difference in the evaporation of water. I mention it as a point worth considering.

Dr. JOHN M. SWAN: It seems to me that in this discussion too much stress has been laid upon the effect of floods and not enough upon the continuous flow of water in small streams. For the past year I have been living in a partially deforested region, the streams of which are tributary to the Chemung River. In this region I am told that streams which, years ago, ran fairly full all summer, and which were used for turning mill-wheels and which contained fish, are now completely dry during the summer months. It seems reasonable to suppose that the deforestation of the hills in this region has something to do with the drying-up of these watercourses. There can be no question as to the economical advisability of clearing land that is suitable for agricultural purposes. It appears to me, however, an erroneous economic procedure to cut the trees completely from land which cannot be so utilized.

Dr. J. M. ANDERS (Philadelphia): I have been much gratified to see the subject discussed so fully from different points of view. I should like to have heard more said on the question of the humidity of the atmosphere, the production of ozone, and the power of ozone as a purifier of our atmosphere. I was pleased to hear the results of

observations made at Toronto under Professor Stupart, and think that they are somewhat confirmatory of the position I took in my paper. Certainly the extremes of temperature are greater in the absence of woods. Dr. Elliott's suggestion with reference to observations in wooded districts is a very timely one, and I would throw out the further suggestion that stations should also be placed at various points beyond the borders of the forests; in other words, we are pretty well convinced that the forests possess certain definite effects upon the temperature, relative humidity, &c.; but we do not know how far these influences extend beyond their own borders. Surely they must radiate out into the surrounding country, and have an effect upon the temperature and atmospheric humidity, &c., and to what distance these influences reach, should be definitely ascertained, if possible. Dr. Blackader spoke of the possibility of the woodland producing harmful effects. That is true in damp localities if the forest be too dense, and I tried to lay stress on the point that the distribution of woods is a very important matter if we would obtain their best climatic and hygienic efforts. Dr. Hinsdale raised the question as to whether the observation with regard to ozone could be considered conclusive or not. I am free to confess that we cannot say with positiveness that the position taken regarding ozone as the great natural purifier of the air is entirely tenable. It would appear from certain recent observations and writings that ozone is incapable of oxidizing the noxious substances in our atmosphere. On the other hand, in my belief, the balance of testimony is still in favour of the view that ozone purifies the atmosphere in the manner described.

A RÉSUMÉ OF THE OPINIONS UPON THE NAUHEIM TREATMENT OF CHRONIC DISEASE OF THE HEART.

BY JOHN M. SWAN, M.D.

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DURING the past year my attention has been called to the criticism of the Nauheim method of treatment of cases of chronic heart disease, contained in Mackenzie's book [14]. After reading Mackenzie's statements over carefully, I thought it would be valuable to review the books written on the subject of cardiac disease, in order to determine the opinions held by various writers concerning the efficiency of this form of treatment. I have purposely excluded the writings of the Nauheim physicians and papers in the periodical medical press, with one or two exceptions. I have excluded the latter because the practitioner, in determining his attitude towards a "heart case," would be more apt to consult a text-book than to look up references in the literature.

All of the writers concede the benefit to be derived by a course of hydrotherapeutic treatment of a suitable case of chronic heart disease, except Mackenzie [14]. Allbutt [1] is opposed to their use in cases of "overstress of the heart" or heart strain, and Mott [16] is opposed to their use in cases of angina pectoris and arteriosclerosis.

The important point to determine is whether an individual case is a suitable one for the treatment. The indications and contradictions have been so often enumerated that I consider it superfluous to repeat them here.

Mackenzie questions the influence of the Nauheim baths

on blood-pressure, referring to the statement made by the Nauheim physicians that the baths will raise a low blood-pressure and lower a high blood-pressure.

The influence of the carbonated brine baths on blood-pressure in the human patient, so far as I know, has never been carefully studied. I have a series of observations on this subject under way at present, which I hope to report at some future day. I am able to say, however, that while the majority of patients show a higher pressure at the conclusion of the baths than at their commencement, there are some patients in whom the pressure has been lower at the termination of the series than at its commencement. I am not unmindful of the numerous other influences that would tend to modify the blood-pressure at work in a patient who is taking a course of sanatorium treatment.

The criticism "that people with nothing the matter with their hearts were having the same baths as those who were suffering from severe heart affection" is serious, and should be avoided by all who are employing these methods. The only method to be recommended in prescribing hydrotherapeutic measures is that which should be followed in prescribing any other form of treatment. First, carefully study the case—history, physical condition, urine, blood, pulse tracing—and then prescribe the course of treatment which holds out the most hope for ameliorating the condition found. Mackenzie states that the same effect can be obtained by fresh-water baths that can be obtained by brine baths. Whether the same effects can be obtained by fresh-water baths that can be had by the use of brine containing sodium chloride and calcium chloride it is impossible to say. I have begun a series of observations by which I hope to be able to throw some light upon this subject. I am confident, however, that there is more to be accomplished by the use of

carbonated brine baths and resistance exercises than can be accounted for by mental effort. I am sure that these measures produce definite physical benefit in persons who have serious organic heart disease.

I am also positive that patients are often sent to health resorts for "Nauheim" baths by their physician, and that they expect to get "Nauheim" baths when such treatment is not suited to them. By the term "Nauheim bath" I mean a cold brine bath in which free carbon dioxide gas is liberated. I would urge the abandonment of the term "Nauheim," and the substitution of the term "brine" for these baths. I would also urge the elimination of the notion that all patients should have carbon dioxide in the baths, because often the addition of the gas seems harmful.

I am unable to refute the statement that the effect of the baths are due merely to the temperature of the water. The temperature of the water is a very important factor, perhaps the most important, in the result, and should always be carefully considered.

I am in hearty agreement with the position that persons who have no organic heart disease and growing boys and girls with functional heart weakness should not be made to think that they have a serious cardiac disorder. If hydrotherapeutic measures seem advisable in these cases the patient should be carefully informed that these measures are not recommended on account of their relation to the heart, but because of their beneficial influence on general health.

"The assembling in crowds of neurotic people is a bad feature." Every physician who has worked in a sanatorium knows this. No one has yet devised a plan by which patients who are being treated at health resorts can be stopped from detailing their symptoms to anyone who will listen.

How these baths produce their effects is not definitely

known. I agree with von Jürgensen [13] that the treatment is a purely empirical one. I think we may disregard the extravagant claims of the Nauheim physicians concerning their effects on metabolism, &c. It seems to me that the most important effect is the equalization of the distribution of the blood in the skin and the viscera by the vasodilation produced in the vessels of the former organ, the skin. This view is held by Colebeck [6], Hare [8], Bishop [4], Anders [3], and Merklen [15].

Anders [3] also refers some of the benefit to the improvement of the impaired nutrition of the myocardium by the freer coronary circulation. Von Jürgensen [13] believes it probable that an over-distended heart is relieved of its burden. Hirschfelder [11], Mackenzie [14], Poynton [22], and Samson and Gibson [23] ascribe the beneficial results to mental distraction, favourable climatic conditions, and rest. Merklen [15] believes that there is a reflex action on the myocardium by excitation of the sensory nerves of the skin.

The statement of Schott that increased tissue change, together with a reflex stimulation of the heart, which causes its slower and more powerful contractions, with a physiological stimulation of the arterioles and capillaries by the passage of the gas and salts through the skin has never been substantiated, and I think is a highly fanciful explanation. I do not believe that the unbroken skin will allow the passage of gas and salts.

The sanatorium regime in the treatment of chronic cardiac diseases, which includes rest, diet, hydrotherapeutic, and mechanotherapeutic measures of various kinds is productive of benefit. The influence of rest, regular habits, a diet of digestible materials, well cooked and well served, and the relief of mental anxiety are important factors in the result.

The carbonated brine baths in suitable cases do good, I

believe, on account of the evening up of the circulation by the resulting dilation of the cutaneous vessels, thereby relieving the peripheral resistance to the heart's work. The resistance exercises do good by strengthening a weak muscle through exercise of that muscle.

The treatment is indicated in cases of cardiac weakness following the acute infections, such as typhoid fever and influenza; in cases of cardiac weakness accompanying debilitating and wasting diseases, such as diabetes mellitus and pernicious anæmia; in cases of cardiac weakness following severe hæmorrhages and the secondary anæmias; in cases of cardiac weakness following surgical operations; in the early cases of failure of compensation in chronic valvulitis; in cases of simple dilation; in cases of cardiac neurosis and in cases of tachycardia and arrhythmia. In the last three cases the treatment must not be expected to be followed by as uniformly favourable results as in the others.

The treatment is contradicted in cases of nephritis, aneurysm, advanced arteriosclerosis, and severe cases of broken compensation with œdema.

In early cases of fibroid myocarditis with high blood-pressure and beginning arteriosclerosis, the baths, if given at all, should be given with great caution. I am inclined to think that they would best not be given; but I am open to conviction on this point.

Below I append abstracts of the opinions of various authors upon this method of treatment.

Allbutt [1]: We cannot hope to treat the cases discussed in this article (overstress of the heart) efficiently so long as our notions of them remain confused and indiscriminate. As long as the name "heart strain" is used loosely, so long will therapeutical means be as loosely considered and applied. Yet for no cases are discretion and sagacity more important.

To lay a boy or young man aside from the useful and cheerful current of his education and his sports is, when a necessity, a harassing and unhappy necessity, both for life and character. If we are compelled to turn a cheery manly boy into the twilight of wistfulness and introspection, perhaps into morbid whims and insidious decadences, we must be sure of the necessity, and clear about the economy of our methods, and the accuracy of our aim.

Unfortunately, as we have seen, after strain in persons in middle or latter life the cardiac functions, do what we may, are never wholly restored; and the rest of life is hampered, crippled, or even cut short. In such cases I have not found, nor as an onlooker observed, any advantage in the Nauheim or Oertel methods, unless perhaps in the convalescence of those favourable cases which do fairly well under almost any competent medical management. In these they will be undesirable until they become unnecessary. On the other hand, more than once in strain cases I have seen harm from them.

Anders [2]: Schott, of Nauheim, has introduced a special treatment by baths that is applicable to most forms of valvular disease, simple dilatation, and nervous affections of the organ. The beneficial effects are principally attributed to the salt, which acts as a cutaneous stimulant, and to a slighter degree to the gaseous ingredients of the bath.

Anders [3]: The sceptically minded ascribe the rationale of the phenomenal results achieved to the good effects of rest and a peculiarly attractive environment. Granted that a salubrious environment shares in the production of the beneficial effects, the principal and most influential factors to the attentive and practised observer are unquestionably the systematic and methodic use of the saline baths and the "resistance movements." The baths exert a beneficial influence in

various directions in cardiac insufficiency, and prominent among the salient results are more vigorous systole with diminution in the size of the dilated heart, and a reduction of the pulse rate. The diminution in the size of the heart is readily established, both by percussion and the use of the X-rays. Of equal importance is the influence exerted upon the bloodpaths by means of which there is accomplished an arteriodilation and transfer of the abnormally large increment of venous blood to the arterial side of the circulation. The blood-pressure, as shown by Professor T. Schott, is generally raised, but when it is too low at the start this effect is not observed.

It is especially noted that in consequence of a freer coronary circulation the impaired nutrition of the myocardium is correspondingly benefited. The labour of the overburdened heart is greatly diminished and its recuperation to a like extent assisted. Indeed, as the result of personal observation the writer is enabled to affirm that all of the usual evidence of an impaired circulation presented by the different organs (lungs, liver, stomach, kidneys), as well as the anasarca, disappear as the heart's capacity for physiologic work augments under the influence of balneologic therapy.

Bishop [4]: The Nauheim treatment is particularly applicable to this form of disease (high pressure cases), no matter what its origin, and its great success, though supposed to be due to a direct action upon the heart, is really due to the correction of disorder of the arterial system, particularly in cases in which there is commencing secondary low blood-pressure.

The great service for the proper treatment of heart and arterial disease that has been done by the Nauheim physicians, beyond calling attention to the curative action of the springs in general, consists in working out these gradua-

tions; in a word, in individualizing the patients that come to Bad-Nauheim for treatment. One often hears of the harm that the effervescent thermal baths have done in this and that case of cardiovascular disease, and it is true that much harm has been done in this fashion. The trouble, however, has not been with the treatment *per se*, its principles being sound, but in the false application of treatment which may conveniently be compared to insufficient or over-sufficient dosage in the treatment of disease by drugs. The warning may not be out of place, then, that "heart patients," as the Germans call them, should take all possible care in putting themselves in the hands of persons who profess to use Nauheim methods of treatment.

Broadbent and Broadbent [5]: The treatment cannot, of course, cure a valvular lesion, but it may give beneficial results in suitable cases. But it is rather in cases of cardiac dilatation from loss of tone after influenza, or some depressing disease, than in actual valvular disease, that it is satisfactory. The change of air and scene, the sedative life, the early hours, and the regular meals, together with freedom from excitement and worry, and the satisfaction engendered by "taking a cure," will be among the most important factors which contribute to its success in this class of cases.

In view of the tendency to dilatation in acute rheumatism and influenza, and after any acute bacterial infection, when the heart muscle has been more or less damaged by toxins, a period of rest, with avoidance of any undue exertion, is advisable after an acute illness. Loss of tone of the cardiac muscle, with a certain degree of dilatation of and, it may be, irritability of the heart, is especially liable to occur after an attack of influenza, and is frequently associated with mental depression and loss of nerve tone. This class of cases is usually much benefited by the "Schott" treatment of baths,

as the daily routine, enforced period of rest, the sedative effect of the baths, the change of air and scene, with absence of excitement and mental exertion, is highly beneficial. It is by no means essential that the patient should go to Nauheim, as treatment can be carried out in his own home, or at various bathing stations in England.

The hydrotherapeutic treatment is usually only necessary in cases in which there is an element of neurosis, cardiac irritability, or mental depression, when the psychological element must be taken into consideration.

Colebeck [6]: The physiological interpretation of these results (slowing of the pulse-rate, with an increase in the volume and force of the beat, and a decrease in the area of cardiac dulness, *i.e.*, an improved circulation with a diminution in the size of the heart), though still *sub judice,* is in all probability that the baths and exercises give rise to dilatation of the arterioles in the skin and muscles respectively, with a consequent reduction in peripheral resistance and a fall of mean arterial blood-pressure. The widening of the arteriolar bed in the skin and muscles, as the case may be, drains the blood from the venous to the arterial system, and more particularly from the visceral to the systemic circulation. The heart is relieved, therefore, both on the arterial and the venous side of the circulation, inasmuch as the organ is contracting against diminished resistance with a decreased load. The fall in the pulse-rate is not, in the opinion of the author, a serious objection to this view. Speaking generally, the subjects of mitral disease derive greater benefit from baths and resisted movements than those suffering from aortic lesions. In myocardial affections the treatment is sometimes of very great service. Widespread arteriosclerosis and advanced cardiac failure are contraindications of the employment of this form of treatment.

Gibson [7]: No one who has been to Nauheim can for a moment doubt the powerful activity of these baths under physiological conditions, or their beneficial effects in certain pathological states.

It has been customary to explain the action of these baths by an increase in tissue changes produced by greater power of absorbing oxygen by the cells. When injudiciously used the baths are apt to cause restlessness and sleeplessness, followed by lack of appetite and loss of strength.

Hare [8]: In many instances when the heart is feeble as the result of fibroid changes in its muscle or when the patient is convalescing from some disease like influenza, which seriously impairs the functional activity of those organs, excellent results are sometimes obtained by the institution of what is known as the Nauheim baths.

The circulation is equalized, internal congestions are overcome, and the heart finds it easier to pump blood through the dilated superficial capillaries than under ordinary conditions.

It is important to note that the resistance exercises which are carried out in connection with the plan of treatment are probably equally beneficial, if not more beneficial than the baths themselves.

Heftler [9]: One conceives easily that if such are the immediate effects of a bath, their repetition more or less daily during the lapse of time necessary to constitute a complete treatment ought to produce considerable results. We see, in fact, the visceral congestions, principally of the liver and kidneys, diminish or disappear, and the pulmonary circulation become free and permit a more complete oxygenation of the blood. We see the respiration become more deep and the cyanosis of the face give place to normal coloration. As a consequence of the regulation of the general circulation

and parallel with the augmentation of the diuresis, one proves the diminution of œdemas and other serous transudations. The tissue changes are active as the nutrition of the organism in general and of the heart in particular, which, more abundantly irrigated by the coronary arteries, undergoes an increase of force and favourable modification of its pathologic state, provided its fibres have not lost all possibility of morphologic restoration.

The general condition of the patient improves, his appetite increases considerably. Those of the patients, who for different reasons inherent to the condition of their hearts were incapable of taking the horizontal position and were obliged to pass their nights in an arm-chair, sleep in the normal position of the body; others who were only able to walk upon a level path with the development of a painful dyspnœa, take walks of varying length without effort. Each time that the circumstances allow we recommend patients to terminate their treatment by an Oertel course.

Heinemann [10]: No form of treatment in the range of medicine, which is applied to chronic disease and often apparently hopeless cases, for whom distinguished skill and money has done everything available, can show a larger number of improved patients whose energy has been restored in various degrees and whose lives have been prolonged for indefinite periods of years.

Hirschfelder [11]: As Mackenzie states, it is chiefly due to the element of mental distraction, combined with the judicious supervision of a physician and the favourable climatic conditions, which make the spa treatment of cardiac disease so successful; although, as he stated, each spa physician has evolved some method of treatment which he regards as of special benefit, when the actual benefit has been due to the air and restfulness itself. Nevertheless, it must

be confessed that the treatments at Nauheim by the late August Schott have been of great benefit, and being founded upon sound physiological doctrines, have been applicable elsewhere as well. The physician must always realize that, however little there may be in the spa treatment *per se*, the combination of the mental rest and change of air with the baths and dietetic treatment is one which the patient, whose condition warrants a trip, should not forgo.

Huchard [12]: A single hydromineral station cannot agree with all cardiacs. In Germany one has elevated, or rather debased, Nauheim to the rank of a panacea. This station receives all cardiopathies; it treats the most variable cases; valvular, arterial, or functional disturbances, cases of hypertension as well as cases of hypotension, cardiacs and pseudocardiacs; it cures all, angina pectoris, overstrain of the heart, all the arrhythmias, all the tachycardias, all the palpitations; it resolves valvular exudates, it retracts the heart, and although it contains too much chloride, it is sedative, to become excitant or tonic following the needs of the case.

I am not the enemy of carbogaseous baths, which ought to render very great service in well-determined cases, but I am the enemy of a systematic medication for all cardiacs, and it is for this reason that several hydromineral stations in France have been instituted to respond to the therapeutic indications of the different cardiopathies.

Von Jürgensen [13]: How they (Nauheim baths) act is not definitely known, and the attempts to explain the rationale of the procedure have in my opinion not proved successful. I therefore regard the method as a purely empirical one and present it in that light.

The object of the procedure is to enable a dilated heart that is unable to expel all its contents to empty itself com-

pletely. At first this object is only partially attained, but as the treatment goes on the ventricle empties itself more completely. The nutrition of the heart muscle is improved as the dilatation subsides and the circulation becomes more active.

The crux of the question is whether this assumed effect on the heart can be positively proved. If that is the case, then the therapeutic results are quite comprehensible.

I can personally testify that the Schott method of gymnastics is capable in a short time of considerably diminishing the cardiac dulness and at the same time strengthening the pulse. These results practically admit of no other interpretation but that given by August Schott, the originator of the method—that the over-distended heart is relieved of its burden.

Mackenzie [14] : I feel it would be misleading if I passed a method of treatment that has obtained a world-wide reputation which I consider out of proportion to its merits.

One physician of experience tells me that every year he is called upon to treat a number of the "Nauheim wrecks," as he calls them, on their return.

I found that ten to twenty years ago, when the notion was prevalent that to have a good heart you must have a strong pulse, these baths had a remarkable effect in strengthening the pulse, raising the arterial pressure 20, 30 and 40 mm. Hg. But nowadays, the fashion being to soften a strong pulse, these waters are discovered to have a remarkable effect in lowering the arterial pressure. So remarkable are these waters that it is claimed that they can increase the pressure when it is low, and lower the pressure when it is high.

I found that these baths were so modified as to be of different strength, and it was stated that the different baths

were given according to the nature of the complaint. But I could find no evidence of any rule being followed. I found that people with nothing the matter with their hearts were having the same baths as those who were suffering from severe heart affection. I also found patients with a weak, frequent pulse having the same baths as others with slow, hard pulse.

I saw nothing which, by the greatest stretch of the imagination, could confirm the statement that patients are to be seen entering these baths bent and ill, and coming out of them well and strong. In the patients I watched in the baths I could discover no improvement from the single immersion. Certain effects on the heart, such as slowing of its action, did occur in several cases, notably in healthy hearts, as in my own case, and in that of a friend whom I watched. This was in the strong Sprudel bath, when the temperature of the water was 89° F. But it seemed to me merely a temperature effect, and this was confirmed by the fact that when I returned home I found my pulse-rate and that of my friend slowed in exactly the same manner when we lay in a bath of ordinary tap-water at the same temperature.

It may be said, and truthfully, that large numbers of people flock to Nauheim, and many of them derive great benefit from the treatment. I recognize this, and have carefully endeavoured to find out the reason for the success of the Nauheim methods. When the cases that are cured and the causes of their cure are strictly analyzed, it will be found that at Nauheim what I call the essentials of treatment are carried out in an excellent manner.

Everything is conducive to the restfulness of the patient. It is a pleasant place, sunny and well shaded, with beautiful gardens and an excellent band. People jaded with

their cares and duties find here that repose which is essential to the recovery of the heart. A very large proportion of them are somewhat neurotic, and there is consequently a very susceptible mental element that can be influenced. The patient comes to Nauheim buoyed up with the reputation of the place. When he consults a doctor he is confidently told that the treatment will do him good—at once half the cure is effected in a great proportion of the cases. Of wonderful cures I saw none.

I have gone into the subject of the Nauheim treatment at length, so that the reader may appreciate the strength or weakness of the position I take up, and I want each practitioner seriously to consider his responsibility in every case before recommending an elaborate and expensive treatment. If the individual is well-to-do, and there is not much the matter with him—well, Nauheim is as good a place to send him to as any other. But when it means crippling a man's resources, either by the outlay or by stopping his work, a grave responsibility rests upon his adviser.

In the case of growing boys and girls, I think Nauheim and the various methods are distinctly detrimental, when the heart's weakness is purely functional, and the symptoms consist in occasional fainting and some enlargement and irregularity of the heart. This class of patients is often sent there, and, in consequence of the elaborate ritual, they get the notion that there must be something serious, and go through life under the impression that they have a weak heart, with the consequence seen in the *malade imaginaire*. I have seen numbers of these going through these elaborate methods whom I would have sent to the playfields.

The assembling of crowds of neurotic people is a bad feature. They are so fond of detailing their symptoms to one another that they cultivate the habit of self-analysis.

If this were done sanely, good might result, but it often ends in making the individual too self-conscious of what little infirmity he suffers from.

Merklen [15]: The similarity of action of the bath and of simple mechanical irritation of the precordial region is interesting. It tends to prove that the bath has not only a derivative and vasodilator action, but that it has equally, by the excitation of the extremities of the sensory nerves of the skin, a reflex action upon the myocardium itself. It seems, furthermore, to result from the experiments of Graüpner that the excitation of all parts of the external skin is not equally apt to produce this action. It follows only the excitation of the sensory terminations of the skin of the back, of the thorax, and of the abdomen.

Balneotherapy is, then, a true neurotherapy of the heart. It is in that comparable to digitalis, reinforcing as it does for a time the cardiac contractions, with this difference—that its action is accompanied by peripheral vasodilation.

Mott [16]: Carbonic acid gaseous baths have been recommended, and some authorities proclaim the favourable results in angina pectoris obtained by the use of the baths at Nauheim. This treatment has been much discussed. According to certain authorities the work of the heart is diminished by dilatation of the peripheral vessels, and according to others the result is a general rise of arterial pressure.

Byrom Bramwell and Huchard are of the opinion that these baths only cure the anginal cases of neuropathic origin. In cases of organic angina pectoris, of marked cardiac insufficiency, and of renal sclerosis they are contra-indicated, as they may lead to serious complications.

Osler [17]: The good effects of the bath are claimed by Schott to come from a cutaneous excitation, induced by the

mineral and gaseous constituents of the bath and stimulation of the sensory nerves. There is no question that the bath, in suitable cases, will alter the position of the apex beat, and that it lessens the area of cardiac dulness; this means that it diminishes the dilatation of the heart.

The best cases for the Nauheim treatment are those with myocardial weakness from whatever cause. For valvular heart disease in the stage of broken compensation with dropsy, &c., it is not suitable. The neurotic heart is often much benefited.

Osler and Gibson [18]: The precise mode of action is still under discussion, some attributing the good results to the stimulating influence of the CO_2 on the nerves of the skin; others regard the temperature of the bath as the most important element. Whatever the precise *modus operandi*, the heart is stimulated to more vigorous contraction, and the area of heart dulness is diminished under observation.

Nauheim has become a vogue, and all sorts and conditions of patients from all parts of the world flock there, so that it is by no means easy to form an unbiased judgment on the value of the method. The senior author has been watching carefully the results in many patients who have been under treatment there. They may be divided into three groups. Scores of persons who have nothing whatever the matter with their hearts are greatly benefited by the change and the holiday.

In a second large group much damage is done. For years the senior author has been in the habit of seeing victims of the Nauheim cure, many of them physicians, who have come for advice regarding the long train of troublesome symptoms of the neurotic heart. Frightened by a little irregularity, they have submitted themselves to a Nauheim cure, and have been greatly alarmed to find that,

instead of improvement, they have grown worse. In many neurotic women the last state has been much worse than the first. As a rule, these patients are little, if at all, benefited. Cases of aneurysm, valvular disease in the late stages, broken compensation, arteriosclerosis with very high pressure, do not seem to have done well under this special method.

A third group, in which good results are seen, comprises the chronic cases, the fat patients with weak hearts, the cases of valvular disease with slight disturbances of compensation, but not with dropsy. The baths may be carried out at home, but the same beneficial results are rarely obtained, even in suitable cases.

One thing should be demanded of those who carry out the treatment at Nauheim or elsewhere: they should stop alarming people who have little or nothing the matter with their hearts.

Babcock [19]: In no class is this form of hydrotherapy more beneficial than in those of chronic myocardial incompetence. As with other therapeutic agents, this should not be left for a last resort, but should be instituted early, before marked dilatation has set in. The degree of improvement, objective as well as subjective, is often truly surprising. Since the tendency in these case is for signs of incompetence to reassert themselves after the patients have returned to their accustomed mode of life, people of means should be advised to make the journey to Bad Nauheim every summer.

Caution may well be urged, however, against the employment of such baths without careful study of their indications and mode of action, so far as this is understood.

It is not customary at Bad Nauheim to begin a course of treatment with carbonated waters. Very feeble, dilated hearts do not require, and will not endure, stimulating

baths, but need soothing, slightly tonic baths. Therefore, it is always well to begin with warm saline, but not effervescing waters, and to come to the use of carbonated baths very gradually, and only when the temperature of the water is such as to make it stimulating, and when the heart has gained sufficient strength to enable it to respond to such energetic stimulation as results from cool, strongly saline, and effervescing waters. Hence it is plain that, unless care and judgment be exercised, this form of therapy may become injurious instead of beneficial.

Powell [20]: For these early cases (fatty degeneration) a course of Nauheim baths and exercises may be taken with advantage from time to time, the exercises being especially valuable in aiding by tonic muscular contraction the return of blood to the heart, disgorging the venous circulation, and thus aiding the forward movement. Cold bathing should be forbidden, and a warning given to avoid walking against cold winds. In advanced cases Nauheim baths are not to be recommended. In cases of fatty infiltration Nauheim treatment is suggested in appropriate cases.

Powell [21]: Regulated open-air exercise is of the most importance, beginning with regulated level walks, proceeding to gentle inclines and so on, but never overstepping the limits of cardiac power. Unquestionably Oertel's treatment for cardiac weakness and the Nauheim baths and exercises are valuable in this form of malady [angina pectoris]. It is only to be regretted that the latter treatment has been so "boomed" into popularity for every conceivable form of heart disease and imaginary heart ailment as to discredit its use in appropriate cases.

Poynton [22]: It is most successful in dilation of the heart of moderate severity, the result of infections—for example, influenza—or of imperfect nutrition, as in anæmia

and debility. In valvular disease the tone of the myocardium may be improved, and though in no way curative of the valvular lesion, the exercises are useful preliminaries to more active movement.

The cold light of hospital observation does not perhaps discover such remarkable effects from the treatment as might be expected, but the altered scenes, the regime, and the magic word "cure," all no doubt take some part in the great improvement that has been frequently recorded in suitable cases from the method of treatment. The reader must not be influenced by startling diagrams of heart outlines, but rely more upon the evidence that many sufferers from heart disease have received considerable benefit from a carefully elaborated combination of baths, exercises, diet, rest, and change of scene.

It will be clear, then, that severe aortic regurgitation, aneurysm, and advanced fatty degeneration of the cardiac muscle are not likely to benefit; and the dangers of long journeys and strange surroundings and the sadness of death in a foreign land should not be forgotten.

A diminished area of cardiac dulness after a saline bath is not necessarily an evidence of true improvement. It may only be a transient phenomenon, and then not entirely dependent upon a diminution in the size of the heart, but upon increased expansion of the lungs.

Sansom and Gibson [23]: The concurrence of signs—the evidence of rational as well as of physical diagnosis—however, shows that a combination of judicious bath treatment and physical exercises may be a valuable agency for good in cases of mitral insufficiency with slight failure of compensation. It is a great mistake to send any patient with serious disturbance of equilibrium to any spa such as Nauheim.

One factor in the therapeutics of a health resort must not be overlooked. The change in surroundings must produce an effect upon the higher attributes of the nervous system, the will, the emotions, and the intellect. It is no slight advantage for a patient to be taken away from the little worries of home to a place where, with clear sky and pure air, there are facilities for systematic self-management, a prescribed and regulated dietary, and the associated hope and faith inspired by the favourable experiences of others. Mental and emotional impressions can strongly influence the trophic nervous mechanism of the heart. It is true that there is a reverse to this picture. Patients are sometimes deceived by false hopes and fallacious arguments; persons, for example, the subject of mitral insufficiency, well compensated, and causing no adverse symptoms, have been persuaded by well-meaning but misguided friends that calcareous incrustations and fibrous thickening about their heart valves would, by the operation of a certain "cure," disappear as crystals dissolve in water.

Long and arduous journeys have been undertaken by those who were totally unfit to leave the comforts of their home, and then has followed a sad awakening from the delusive dream. These agencies are potent for good or evil, and every case in which the use of them is contemplated must be carefully considered.

Steele [24]: The prevailing opinion seems to be that the action of the potent waters is largely a cutaneous reflex one exerted upon the heart and the peripheral vessels.

He (the author) cannot, however, forgo an expression of his regret that the advocates of the Nauheim treatment should at its comparatively recent resuscitation have sought evidence in its favour from the results of percussion of the heart, a method of physical examination that is peculiarly

open to fallacy. All the more does he regret this in view of the fact that ample evidence of "betterness" will always be forthcoming in the improvement of the patient's "wind" when the state of the heart has undergone real amelioration.

Tyson [25—26]: Ignoring for the present the rationale of the action of these baths, their therapeutic efficiency is undoubted.

Their immediate effect is diminished breathing rate, while the dilated heart is reduced in size—under favourable circumstances to almost its natural limits. The effect is also to increase the action of the kidneys and that of the skin. These effects are apparent in a free flow of urine, which may continue for days and weeks. Metabolic changes are accelerated and improved; the deep-seated organs, especially the liver and pelvic viscera, are relieved of congestion; while the heart, relieved of its burden and contracting strongly, derives from its improved coronary circulation material for the repair of weakened and damaged tissue.

All cases in which the balance of the circulation is deranged, attended with frequent, feeble, and irregular pulse, dyspnœa, engorgement of the venous circulation and its results, including engorgement of the liver and kidneys, with scanty urine. The typical condition, as already mentioned, is the weak heart of cardiac dilatation.

Whittaker [27]: The heart muscle is best toned by baths and exercise, and the finest results are secured in institutions where they may be obtained together and applied and adapted under intelligent supervision.

Babcock [28]: Ample experience all over the world, but particularly in England, has shown that equally efficient results may be obtained in this artificial way as at Bad Nauheim. All agree in the statement that the effects with artificial waters are the same as with the natural, the chief

and perhaps striking difference consisting in the more powerful effervescence of the latter, particularly in the form of the Sprudel-Strom Bad. Another advantage in favour of the latter lies in the consideration that when a patient goes to Germany he leaves his cares behind him, and while there abandons himself to the one purpose of getting well. On the other hand, I have been assured that, owing to the immense number of invalids who frequent the place, patients are apt to miss the watchful care and oversight which many of them require and receive at home.

If the treatment has been judiciously ordered and overseen, the heart is found to gain in strength week by week, visceral congestions diminish, as evinced by increased diuresis, the colour of the skin grows more like that of health, and the patient gradually gains in vigour and ability to exercise without discomfort.

Just how this balneological treatment brings about improvement is still a matter of speculation and discussion, being by Schott explained on the hypothesis of increased tissue change, together with a reflex stimulation of the heart, which causes its slower and more powerful contraction, with a physiological stimulation of the arterioles and capillaries by the passage of the gas and salts through the skin. By others, in particular Broadbent, the beneficial action of the baths is attributed to dilatation of the cutaneous capillaries, in consequence of which resistance to work of the left ventricle is lessened, and the transfer of blood from the venous to the arterial system is promoted. The objection urged against this explanation is that the rate of the pulse should be increased, rather than decreased, so that there must be some additional influence at work.

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DISCUSSION.

Dr. J. H. PRATT: This is a subject in which I have been deeply interested for some time. In 1903 we opened in Boston a co-operative hydrotherapeutic establishment, and since that time I have had considerable experience with the artificial carbon dioxide baths in the treatment of heart disease. I have made many observations on the effect of baths of different strength and duration on the pulse rate and blood-pressure. I am glad that Dr. Swan has begun a critical study of the effect of brine and carbon dioxide baths, and I hope that his example will be followed by others. It is surprising that a method widely used and highly regarded in Europe should have been so neglected in this country. We have been unable to induce the physicians in Boston to study or use the carbon dioxide baths. They would not even come and see them demonstrated.

My experience has not convinced me of the therapeutic power of the carbon dioxide bath or any of its modifications. There is need of more careful study of the physiologic and therapeutic effect of this form of treatment.

The term "artificial Nauheim bath" is rather indefinite. It is rarely used in Germany, but in England and America all carbon dioxide baths are designated Nauheim baths. The most important springs at Nauheim contain warm water charged with carbon dioxide gas. Similar natural baths are found at Oeynhausen and Soden. It is misleading to speak of a brine bath as a Nauheim bath. We would do well to abandon the latter term and call a brine bath a brine bath, and a carbon dioxide bath a carbon dioxide bath.

Much foolishness has been written about natural and artificial carbon dioxide baths. We are gravely told that the patient's heart must be trained and strengthened by a series of weak baths before giving one of the stronger baths. I followed this rule for years. Then, finding so many assertions in regard to the baths unverified by experience, I tried the effect of a full-strength bath as a test of the functional power of the heart on patients who had never taken the preliminary baths, and no harm resulted.

Give a patient a full-strength bath—carbon dioxide bath (1,000 grammes Na_2CO_3, 1,000 c.c. HCl.)—at a temperature of 90° F. for ten minutes. If there is a drop in the blood-pressure the patient has a weak heart and the prognosis is bad.

In 1908 I found the artificial carbon dioxide baths extensively used in the university clinics of Germany. The high esteem in which the baths were held seemed to rest on general impressions rather than on carefully observed facts. Now Mackenzie is one of the few men who, after a careful investigation, has written in a candid, critical, unprejudiced way about the treatments given at Nauheim. Unfortunately Mackenzie does not seem acquainted with the work of Otfried Müller—a good physiologist and a good clinician.

Müller made careful studies with the plethysmograph and tachograph. He found that the carbon dioxide baths do exert a specific physiological action. Although the cutaneous capillaries dilate, the larger vessels of the periphery contract, while those of the splanchnic region dilate.

Whidden and I found that a rise of the systolic blood-pressure was produced by a full-strength carbon dioxide bath (duration ten minutes, temperature 90° F.) in a series of observations made on twelve individuals with strong hearts. A full bath at the same temperature and of the same duration was given to two of these patients and no rise of blood-pressure occurred.

The improvement often noticed after a course of treatment at Nauheim is not necessarily due to the baths. Three years ago I sent a patient with a dilated heart to Dr. Mackenzie in London. He had long been under the observation of Dr. Musser and myself in this country. When I examined him with Dr. Mackenzie shortly after his arrival I found the cardiac outline reduced in size. After another week of comparative physical rest and complete freedom from business cares, I saw the same patient with Professor Krehl in Heidelberg. To my surprise his heart was then of normal size. This remarkable change took place without the aid of any bath or drug.

When a full-strength carbon dioxide bath, used as a functional test, produces a fall in blood-pressure and an increase in the cardiac outline I never give a second bath. When I say that a single bath does no harm, I mean no lasting harm. I think the

injury is no more serious than that produced by a slight over-exertion such as is often seen when a patient with a weak heart climbs a flight of stairs.

Dr. J. H. LOWMAN (Cleveland, Ohio): With regard to the passive exercises and the resistance exercises a great deal can be done by the general practitioner to shorten the time which a patient will lie in bed after an endocarditis, pneumonia, or other disease, but the resistance exercises should never be given first. It is astonishing what a great effect a very slight resistance exercise will have on weak hearts. One should have a simple scale which would estimate the weight, and put a band on the patient's arm and ask the patient to lift his arm with one ounce of pressure; with this you note, of course, the rapidity of the heart's action. I remember one case in which I was experimenting to see how much resistance could be borne by this patient. He almost fainted after an attempt to raise his arm against a two-ounce weight. Resistance exercises are extremely difficult to endure by anyone who has a feeble heart. With patients recovering from pneumonia, typhoid fever, endocarditis, the exercises should be passive. Good masseurs have been thoroughly instructed on that point; they will begin with passive exercises, say moving the arm up and down three times, and this will have a decided effect. Extremely gentle passive exercises will have an effect on a patient who has been lying in bed quietly for possibly two months. In typhoid, where there is a certain amount of toxic myocarditis, the time of lying in bed is diminished by passive exercise, and also in rheumatic toxæmias with rheumatoid pericarditis the patient will be got up much sooner if he receive passive exercises, and these should be given at least two weeks before any attempt at resistance exercise is undertaken. The first should be a resisting exercise of the hand for half a minute three times; even this will give you a slight difference in the heart's action. We all know of the deplorable accidents after pneumonia. One patient who had had a heart which was absolutely sound contracted pneumonia, and during the course I found him sitting up in bed and on examination found extreme dilatation of the heart. He was in bed two months after this, and has still this trouble years after, simply by sitting up too early. This also happens in typhoid fever. It behoves us, therefore, to hesitate before giving these resisting exercises. In the Nauheim treatment, it is not the carbonic acid nor the brine which is everything; it is the heat, the time of the bath and various things; but the point to be brought out in this treatment is that it should be begun with passive exercise.

I do not quite understand what Dr. Pratt means by saying that there is no harm in giving these baths at once in full strength, even if they do cause a slight dilatation of the heart.

Dr. J. M. TAYLOR (Philadelphia, Pa.): I brought before this

Society ten years ago the subject of my experience in the use of passive exercises in children with chronic heart disease, and I remember Dr. Abraham Jacobi saying that all diseased conditions of the heart should be treated with absolute rest as the only safe method. Since this I have studied the subject more fully, and the present discussion has shown that our ignorance is conspicuous in several important directions. Furthermore, if there is one direction in which the clinicians of America are monumentally ignorant, it is as to the question of the value or disvalue of exercise, passive or active: that is, regulated movements. To-day one thing is made plain, the gravity of the subject, and, therefore, we should study the possibilities of systematic movements. I have given them much thought. It is very important to bear in mind the character and quality of the heart action, and Dr. Pratt has made it clear where this differentiation should come in.

Passive relief from movements is exceedingly important, and is well worthy the attention of clinicians. Of course the grave danger to the heart from extreme weakness in acute conditions such as pneumonia, is an urgent one. I recall one instance. The patient was a magnificent specimen of a man, a teacher of physical culture and very intelligent. He could endure any amount of exposure; his lungs, heart, &c., were all normal. He contracted an influenza which developed into pneumonia, and though he was ordered to bed and the recumbent position, he did not follow my advice, and died suddenly on the tenth day. I am sure that death occurred solely from his unwisdom in insisting upon moving about and putting constant, excessive strain on the heart, already weakened by this deadly toxemia.

Of the value of passive exercises in chronic conditions, we do not yet know much, and here are evidently measures of value which we need to study with the same care given to other more appreciated therapeutic measures.

Dr. KAHLO (French Lick, Ind.): The scepticism as regards the therapeutic results of the Nauheim treatment, as with other therapeutic measures, is due to the fact that these measures are often applied too routinely. Nauheim baths are not more suitable in every form of cardiac disease than any other hydropathic procedure. I think, however, that anyone who has had an opportunity of observing results in Nauheim cannot help but be impressed by the fact that very excellent results are obtained in cardiac cases generally. Of course, one sees a tendency among certain physicians, even there, to advise treatment more or less routinely, but happily this does not apply to all.

Much of the benefit that is to be derived from a visit to Nauheim is in the educational value of the treatment. People learn how to live. The history of many of these cases shows faulty habits of

life, and when these are corrected improvement is the result. The baths differ, of course, for different cases, both in temperature and in the amount of carbonic acid introduced. I am perfectly convinced that the carbonic acid gas does have a decided influence in equalizing the circulation, whether it be introduced artificially or is present in natural form, as in the waters of Nauheim, Homburg, and other resorts in that vicinity.

There is no question but that there is a direct and immediate effect upon the circulation and relief to the heart, which I believe is ascribable to the influence of the carbonic acid gas upon the peripheral nerves. Of course, it is difficult to separate entirely the psychic influence in any treatment of this kind. At Nauheim, patients have rest; they are entirely removed from influences which tend to accentuate their condition, and they learn how to live. The important thing, it seems to me, is for us to properly differentiate those cases which are suitable for this particular treatment from those in which other things are apt to act more beneficially.

Dr. JOHN M. SWAN: This discussion appears to me to show that the term "Nauheim bath" as used in this country, is very much misunderstood. In my opinion the term "Nauheim bath," as usually understood by the practising physician in the United States, is a cold brine bath containing carbon dioxide gas. It is my opinion that patients who are being treated at Bad Nauheim do not always receive cold brine baths containing carbon dioxide gas. I do not know this of my own observation, however.

Many cases of cardiovascular disease will, I believe, be harmed by the use of cold baths. Many of them require warm baths and baths without carbon dioxide gas.

During my year of experience in the institution which I now represent, I have noticed that cases of cardiovascular disease of the most diversified type are sent to us for "Nauheim baths." The patient has been told that he will get cold baths containing gas. When we undertake to give him a different kind of bath, provided the examination shows that the cold baths are not indicated, he naturally feels that he is not getting what his home physician sent him for, and a great deal of the good effect of the treatment is neutralized. Our habit is to examine every patient sent to us very carefully both physically and as to previous medical history, and upon the data so obtained we prescribe suitable treatment.

I believe it is unwise to give a "Nauheim bath" one day and resistance exercises on the following day. In my opinion the patient who is taking the baths is getting rest and is having his peripheral resistance relieved. On the other hand, it is my opinion that resistance exercises increase peripheral resistance. Therefore I believe that the best results are obtained by giving the series of baths first and the exercises after the baths are over; always of course supposing that both baths and exercises are indicated in the individual case.

There is no doubt in my mind but that the baths have a definite physiological influence on the patient, but exactly what that influence is, in my opinion, has not been proved. It is the duty of those of us who are working with this method in this country to make numerous clinical observations on the results following this form of treatment and to publish these results so that we can see from published figures their influence on the patient. Huchard has very properly severely criticised the lack of figures in the previously published articles on this method of treatment.

Dr. EGBERT LEFEVRE (New York): I have been very much interested in the treatment of cardiac diseases by this form of hydrotherapy, the carbon dioxide baths.

I think the profession has gone astray in the use of this plan of treatment by not considering its limitations and not differentiating those cases of heart disease for which this form of hydrotherapy is beneficial from those for which it is absolutely useless or even harmful.

For cases of valvular disease in which there is no increased peripheral resistance, this treatment is practically useless. For cases in which increased peripheral resistance is a predominant feature, this plan is valuable by acting on the circulation and so relieving the overburdened heart. In valvular lesions with high blood-pressure, the arterial sclerotic type of cardiovascular disease, the carbon dioxide bath often gives great relief by lowering the tension and also increasing the general circulatory efficiency, provided that the stage of the disease is a proper one.

In the type with high blood-pressure, we must recognize three stages. First, the stage in which the cardiac power is in excess. The cardiac hypertrophy in this stage has gone beyond the demands of the circulation, and the overpowerful heart in turn excites vascular contraction through the force of the pulse wave. Here vasomotor control is also over stimulated. I doubt if the carbon dioxide baths have any place in this stage. We have other more efficient means to control cardiac over-activity.

Second, the stage of diminished cardiac reserve power. This stage comes on gradually, either through failure of cardiac nutrition or increase in the peripheral resistance. When this stage occurs there is a tendency to angina attacks on extreme exertion or excitement. Later, as the stage progresses, the patient suffers from other symptoms of circulatory insufficiency. It is in this class of cases that the bath either alone or associated with exercise does the greatest amount of good. The bath, by dilating the capillaries in the skin area relieves the pressure at the aortic orifice, and so allows the heart to more completely empty itself of its residual blood. Muscular exertion by dilating the capillaries in the muscle areas has a similar effect. If we limit our treatment by baths to this stage of disease we get the most marked results.

In the third stage we have permanent cardiac insufficiency and also another cause for high blood-pressure and increased embarrassment of the heart, *i.e.*, the imperfect circulation causes more or less retention of CO_2 in the organs. This partial asphyxia causes an increased irritability of vasomotor control. When the circulation in any portion of the body is insufficient, it is corrected normally through the vasomotor system, either dilating the blood-vessels of the part affected or by raising the general blood-pressure. When there is general insufficiency of the circulation through cardiac weakness, the blood-pressure is raised, which adds still further to the work of the heart. In this stage the baths fail to cause dilatation of the capillaries, but on the other hand, increase the blood-pressure, and so cause increased embarrassment of the heart or even produce acute dilatation.

Unfortunately the profession have the opinion that the carbon dioxide bath and the exercise treatment should be used in this late or asphyxia stage. They are asking of the bath treatment what is impossible and physiologically incorrect. The blood-pressure is not always a correct index of therapeutic results. Frequently when taking the blood-pressure in a patient during an attack of angina pectoris we find that the giving of the vasomotor dilators, while the blood-pressure as shown by the instrument is but slightly influenced, the patient has relief from the symptoms, showing that the overburdened heart is getting rid of residual blood and therefore is doing its work more efficiently. Why has our blood-pressure not fallen? Our cardiac power as measured by the sustained blood-pressure is 190 mm.Hg., while a power equal to 210 or 220 mm.Hg. is necessary to meet the circulation efficiency. Now, vasomotor dilators, by relieving the peripheral resistance permit the heart while still working at its maximum power, 190 mm.Hg , to meet the demands of circulation, and, while we have had no change in the blood-pressure, the heart has been able to relieve itself of its residual blood.

Dr. J. M. ANDERS: I think it unfortunate that the Nauheim method of treating cardiovascular diseases is not something more definite than it appears to be in the literature at the present day. Dr. Swan in his paper spoke of the brine baths at one moment and at another of the brine baths plus resistance exercises, as though they were one and the same thing. We must keep clearly in our minds the fact that the Nauheim method and the so-called Schott method, which consists of two main elements—the brine baths and the resistance exercises—are not identical. The majority of practitioners at the Nauheim springs do not practise the combined brine baths and resistance exercises; they think it wholly unjustifiable to apply the so-called Schott method routinely to cases that present themselves for treatment.

At the present day the tendency is more and more toward in-

dividualization; in other words, there is no single method of treatment for cardiovascular cases at Nauheim, but there is a treatment for the individual case as a rule. Along this line I am entirely in accord with what Dr. Swan has intimated. In markedly neurasthenic cases the brine baths plus resistance exercises would seem to over-stimulate the heart and render the patient sleepless. Indeed, in some of these cases the brine baths alone would seem to be too stimulating. On the other hand, the resistance exercises alone may be beneficial. It is generally conceded that the Nauheim treatment is contra-indicated in cases of aortic incompetency. The resistance exercises alone, however, if carried out carefully will oftentimes prove of the greatest service. I believe, however, that the majority of those cases that are suitable for treatment at those springs do best when they receive the combined baths and resistance exercises. Such, at all events, has been the result of my observations during a visit to Bad Nauheim. In simple dilatation of the heart as a result of overstrain, in mitral regurgitation, in mitral stenosis, particularly in the early stages of failure of compensation with slight œdema, cyanosis, dyspnœa, and in the early stages of arterio-sclerosis, the so-called Schott method, consisting of the two main elements mentioned, really gives brilliant results as a whole. Of course something must be attributed to the salubrious environment in which these people find themselves and their extrication from domestic cares, worries and business anxieties. I find that while a few physicians seem to have a definite idea of the contra-indications to the Nauheim baths, the majority certainly cannot have clear ideas on the subject, because many patients are sent there that are wholly unsuitable and very naturally receive no benefit.

The question arises with us as to whether the home use of the Nauheim baths can be made efficient. Personally I do not think it can, because the patient must miss the environment already mentioned, and the freedom from care, worries, and business anxieties. On the other hand, it must be granted that these disadvantages may be overcome at certain springs now established in the United States. I learn with a great deal of pleasure that the French Lick Springs have recently installed an efficient equipment for the administration of the Nauheim baths. They may be also had at Glen Springs, N.Y., and the Virginia Hot Springs, so that with the perfection of the details of the treatment of these salubrious resorts we need not send our patients so far away as Nauheim.

ON THE RECORDING OF PHYSICAL FINDINGS IN THE LUNGS, WITH A SCHEME OF NOTATIONS THEREFOR: AN ABSTRACT.

BY DR. C. L. MINOR,

ASHEVILLE, N.C.

The great difficulty in settling upon a system of notation for the recording of physical signs is that our nomenclature is unsettled, and until everybody uses a similar nomenclature it will be very difficult to adopt any uniform scheme of notation.

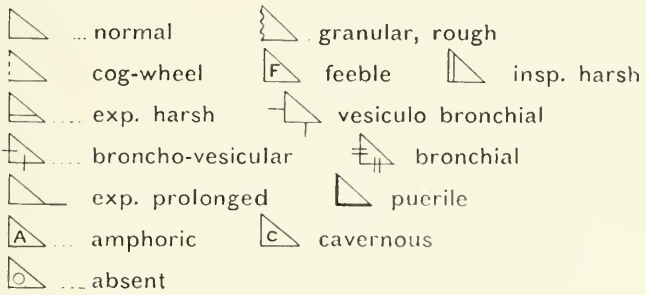
There have, as you know, been many systems proposed, and I am not speaking to you to-day in the vain hope that any system I could present could be so fortunate as to win the approval of all my auditors, let alone that of the profession as a whole; but talking over the matter may induce some of you to study it and apply some form of notation in your work with, as I believe, benefit to its accuracy.

Of course no system can entirely take the place of written notes, and at times you will wish to supplement signs by written descriptions. However, the scheme I propose is an easy one to use, very elastic, quick to record and quck to read, so that a glance at the chart will inform you of the conditions of the lung. I need not say that there is nothing original in this system, but that, like all other systems, it is a combination of some of the author's own ideas with those of other men.

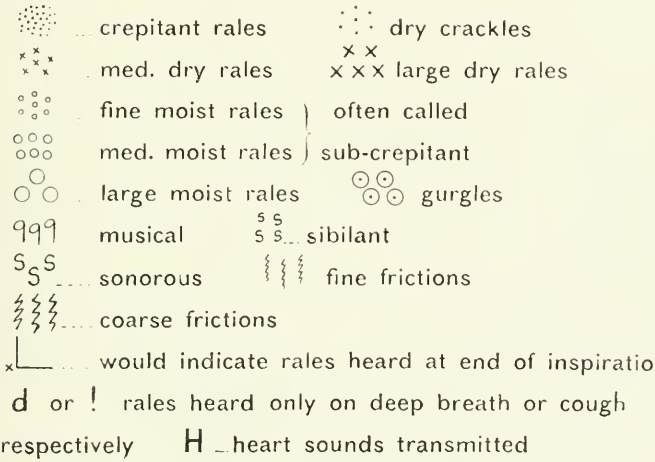
In the beginning I have adopted Sahli's plan using a vertical line to represent inspiration, and a horizontal one,

Dr. MINOR'S SCHEME OF NOTATION.

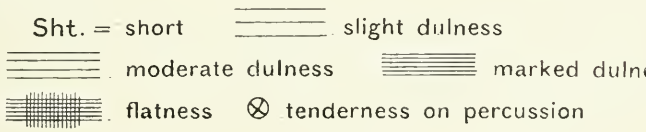
BREATH SOUNDS



RALES



PERCUSSION



at right angles to it, expiration, but as this gives no certain way of indicating prolongation of expiration, I have connected the two ends of this right angle by an hypothenuse, any prolongation being shown by the expiratory line extending beyond this point.

Again, since it is hard to tell how heavy you have meant any line to be, it is better to indicate harsh breathing by double lines, rather than by heavy ones.

Thus I would represent normal respiration by a right-angled triangle, the expiration being the base, the inspiration the vertical side; rough or granular breathing (Grancher), by a wavy line of inspiration; cog-wheel or interrupted breathing, by a broken line; feeble breathing by an F inscribed in the triangle; harsh breathing, by a double line; vesiculo-bronchial, by a line drawn to but not across the inspiratory and expiratory lines; broncho-vesicular, by a line drawn across the inspiratory and expiratory lines; and bronchial by a similar double line; prolonged expiration, by a prolongation of the expiratory line; puerile, by a heavy line; amphoric, by an inscribed A; cavernous, by a C; absence of respiratory sound, by an inscribed O. It is very easy to record any other changes of the breath-sounds in this way.

The adventitious sounds (following the American practice) I divide into moist and dry: the former represented by fine, medium and large circles, while gurgle is indicated by a large circle with an inscribed dot; musical moist râles by a circle with a tail to it like a musical note.

Of the dry râles I represent crepitant râles and dry crackles respectively by abundant or scanty fine dots; medium size dry râles by small crosses; large ones by large crosses; and sibilant and sonorous râles by small and large S's, while frictions are indicated by zigzag lines.

To indicate in which phase of respiration a râle is heard, I

mark at the side of the chart a triangle with a cross or dot at that portion of the respiratory excursion where the sound is heard. Likewise, to indicate whether the râle occurs only after deep breath, or only after cough, I mark a D beside the chart to indicate the former and an exclamation point to indicate the latter.

The percussion findings are easily indicated by different degrees of shading. Charts kept in this way give you very quick and accurate information as to the exact location of physical signs—and more accurately, I believe, than written descriptions can do. Slight changes in the findings are very quickly noted. Could such a system be generally adopted it would, moreover, be a great convenience in the interchange of information as regards cases between doctors.

DISCUSSION.

Dr. J. H. Elliott: Dr. Minor has explained those symbols which represent the intensity and duration of the respiratory murmur, but says nothing as to how to indicate pitch. This is extremely important where one is dealing with acute respiratory diseases, such as pneumonias, &c., and acute conditions in tuberculosis. Is this provided for?

Dr. Lawrason Brown: It is all very good when a man develops such a system for himself, but it remains purely for himself. Take, for instance, a man in charge of a sanatorium where his assistants are changing all the time. Each of them has to be trained in the methods of using the graphic symbols, which certainly increases the chances of error. Furthermore, many sanatoriums change their resident physicians, and each man might like to make changes or additions. You can readily see what confusion would follow in the records. Then, again, you have to have a special chart for percussion, and one for auscultation, &c., and if you keep records of patients for some time you will become pressed for want of room. In most sanatoriums one is required to get down this information in as small a space as possible. In our sanatorium, every examination is written up in full detail and the first and last examinations are

charted. The only things that are charted, however, are the percussion note and the adventitious sounds. We do not attempt to put on the chart changes of breathing. By using this method you can see at a glance the extent of the disease, and after you have seen that you have got the main thing from the chart that you wish you can then sit down and study the minor details of the examination from the description.

Dr. STANLEY G. MINER: This paper of Dr. Minor's is very clever and I am exceedingly interested in both the subject and paper because, having taught physical diagnosis for twenty-five years, I found that almost every text-book had different symbols, making it very difficult for teaching purposes, and in my correspondence with physicians I find that almost every man uses a different set of symbols. Now it does not make any difference if Dr. So-and-So's system is better than somebody else's, but I think it is opportune and within the duty of this Association to take up this subject and suggest at least the adoption of a universal code by the profession. I receive charts from many sources and each man has a different set of symbols. Some use symbols altogether. In my clinics we have two sets, one for the instructors which the students cannot interpret, and another for general use. I think all the different sets of symbols are good, but as an old teacher on this subject I would like to see some action taken by this Society towards furthering this end. Other medical societies have considered this subject, but nothing definite has been accomplished.

Dr. C. L. MINOR: Nobody, I realize, ever adopts unchanged anybody else's system, but I believe there are points in the one I have brought to your attention which will appeal to you.

Dr. Brown says he writes out his cases in detail to save space. I doubt very much if he saves space and I am sure that he cannot save time, although there are some who would write a better description than they would draw.

In this connection let me note that it is very wise when you have finished examining a case to write on your chart, whether written or drawn, the general impression which the case has made upon your mind, as however carefully you may look over or read over the records in the future, you will never get quite the same impression as you did at the time of your examination.

Dr. Elliott asks me how I would record tubular breathing. As a result of a pretty careful study of literature of breath-sounds I believe that "tubular breathing" is but another name for "bronchial," a sign for which I have indicated.

As to the question of differences in pitch, these I indicate as was first suggested by Dr. Page, of New York, by a change of angle in inspiratory or expiratory lines.

THE CAUSES OF DEATH IN PULMONARY TUBERCULOSIS.

BY LAWRASON BROWN, M.D.
SARANAC LAKE, N.Y.

RECENT advances in the study of tuberculous infections clothe with fresh interest even the causes of death in chronic pulmonary tuberculosis, and lend to the study of our failures the hope that here also we may gain some knowledge to aid us in our further struggle against this disease.

Life, says Bichet, may be divided into two parts, of which the one, the animal, is governed by the brain; the other, the organic, by the heart and the lungs. When one of these organs ceases to act, the others cannot function; and as they are the three centres where all the secondary phenomena of the two divisions of life come to an end, the phenomena are inevitably cut short, and general death ensues. Death in chronic pulmonary tuberculosis is brought about most often through pathological changes in the lungs, less often by those occurring in the heart or brain.

When one considers the pathology of pulmonary tuberculosis, especially in the more advanced stages, it seems almost incredible that the patient could escape the many imminent accidents that seem so closely connected with such pathological changes, to die finally in the usual manner from a gradual decline of all his bodily functions with asthenia. The destructive processes in the lungs are usually accompanied by many attempts at reparation, with formation of much fibrous tissue, which seriously hampers the fraction of lung which still functions. The slow absorption of

poisons from the many foci, the lack of sufficient oxygen, the excess of CO_2, the failure of the different excretory systems, all bring about some degenerative changes in the various organs which hasten the fatal end.

This study of the causes of death in chronic pulmonary tuberculosis is based on data obtained from the records of death of 1,204 patients who have died at or after leaving the Adirondack Cottage Sanitarium, and from 378 deaths which have occurred in Saranac Lake village.* As soon as it is learned that a former patient of the Adirondack Cottage Sanitarium has died, a brief death report requesting information in regard to the date, place, and cause of death, and the name and address of the attending physician, is sent to the family. The physician is then sent a report which requests again the date, place, and inquires more fully into the details connected with the death of the patient, such as the primary and immediate cause of death, the complications, tuberculous and non-tuberculous, and the presence of nephritis or cerebral symptoms. It was impossible for various reasons to obtain what could be considered reliable data concerning 245 patients, which limits the study to 959 deaths. The accuracy of the data concerning these cases depends of course upon the acumen of the men who observed the patients during the last few weeks or months of life, and on account of lack of interest in pulmonary tuberculosis, and possibly of some fear of the disease, the cases may not have been studied as carefully as they should. Autopsies were performed in few, and the data may be looked upon as purely clinical. In regard to the patients observed in Saranac Lake, all of these facts do not hold good, but here, too, autopsies were rather infrequent.

* I want to thank Dr. E. R. Baldwin, Dr. C. C. Trembley, Dr. H. M. Kinghorn, Dr. J. W. Price and Dr. S. F. Banchet for their aid in the preparation of the latter statistics.

Classification.

While the usual cause of death in chronic pulmonary tuberculosis is asthenia, the complications which terminate life are very numerous, and may be grouped under four heads: (1) General miliary tuberculosis, (2) pulmonary, (3) extra-pulmonary complications, and (4) sudden death. Under pulmonary complications may be mentioned hæmoptysis, pleurisy, gangrene, pneumothorax, generalized subcutaneous emphysema, empyema, pneumonia, caseous and lobar, &c. The extra-pulmonary complications fall into two groups, tuberculous and non-tuberculous. Under the former occur meningitis, tuberculoma of the brain, laryngitis, enteritis, pericarditis, peritonitis, genito-urinary tuberculosis, Addison's disease, &c. Among the non-tuberculous extra-pulmonary complications may be mentioned nephritis, various circulatory conditions, syncope, thrombosis and embolism of the pulmonary artery, diabetes, and during that stage known as "arrested tubercle" any of the causes of death to which the flesh is heir, which produce death irrespective of the presence or absence of pulmonary tuberculosis.

It is comparatively easy to arrange such a classification, but most difficult to fit cases into it. In other words, it must be remembered that asthenia, asphyxia, and syncope are really functional conditions or states, while under the second division of complications definite pronounced pathological changes were used as a basis for classification. No doubt many of the cases included under complications died of asthenia and certainly a number of those grouped under asthenia might be placed under the various complications. However, the most pronounced symptoms were used as the basis for classification.

It has seemed impossible to bring the inflammatory con-

ditions known as broncho-pneumonia, specific and non-specific, so frequent in the terminal stages of chronic pulmonary tuberculosis, where death occurs rapidly, into harmony with the classification, and they have been omitted.

Definition of Terms employed in Classification.

It seems advisable, in order to prevent confusion, to define somewhat the terms employed in this classification.

Asthenia.—A patient was said to have died of asthenia when he lost his strength little by little and at last sank and died through sheer exhaustion. This may come on rapidly or may develop slowly through many weeks.

Asphyxia.—This term has been applied to those deaths which occurred with great cyanosis and marked dyspnœa. An autopsy might have revealed miliary tuberculosis or possibly some complication not suspected

Syncope.—The following is a typical case of death by "syncope" as employed in this classification. The physician was calling upon the family of the patient. She had gone out on the porch about three-quarters of an hour before her death and was feeling very well. Suddenly, without any warning, she died.

Death in chronic pulmonary tuberculosis may be sudden, which is unusual; rapid, which is not infrequent; or slow, which is the usual type, and gives to this form of the disease its common name consumption.

Rapid Death.

Rapid death is more frequent than sudden death, and occurs often during a temporary arrest of the disease. A slight hæmoptysis may be the first indication that all is not going well, and in a week or ten days the patient is dead from asthenia. The sudden spread of the disease from an

old focus produces miliary tuberculosis, and death ensues from tuberculous poisoning. Death in pneumothorax, meningitis and pericarditis, as well as in broncho-pneumonia, is more often rapid than sudden. Death from acute tuberculosis is usually rapid and may be brought about by asphyxia, when the lungs bear the brunt of the infection; by meningeal symptoms when the meninges are more affected; or by asthenia when the secondary tubercles are more gradually diffused throughout the body.

Sudden Death in Pulmonary Tuberculosis.

Sudden death in pulmonary tuberculosis is unusual and may be due to hæmoptysis, hæmorrhage into a large cavity, asphyxia due to the sudden discharge of the contents of a cavity or abscess in the bronchi, the blocking of the trachea by a calcified lymph gland, pneumothorax, double pneumothorax, embolus or thrombosis of the pulmonary artery, the entrance of air into the pulmonary vessels, cardiac syncope, acute miliary tuberculosis, pleurisy with effusion, œdema of lungs and other causes.

Recent work has drawn much attention to that state of hyper-sensitiveness known as anaphylaxis. It has been used to explain many phenomena in the symptomatology, diagnosis, and treatment of pulmonary tuberculosis, and I want to draw your attention to it in connection with some of the instances of hitherto unexplained sudden deaths in pulmonary tuberculosis. It is unnecessary to recall the symptoms of anaphylactic death in the guinea-pig, which Schultz has recently shown to be due to a general contraction of all the unstriped muscle. Owing to certain anatomical peculiarities in the bronchi of the second order, anaphylactic death in the guinea-pig is really a form of asphyxiation. In man this phenomenon of anaphylactic death has

been observed most often in individuals who were or had been asthmatic, a condition which produces apparently some anatomical peculiarities in the pulmonary mucous membrane. Anaphylactic poisoning does not always manifest itself by sudden death from anaphylactic shock, but death may occur in a short time. It is readily conceivable that enough tuberculous poison may gain entrance into the circulation at one time or another, possibly during a slight hæmoptysis, to affect profoundly a patient suffering from tuberculosis and even cause sudden and unexplained death. In a recent case, a patient had had during a period of improvement, several moderate hæmoptyses. He showed at once evidence of profound asthenia, with greatly reduced systolic blood-pressure (75 mm.) and died in about ten days. The pulmonary lesion, discovered at autopsy was totally insufficient to explain the death and there was no general tuberculosis.

A few cases have been reported where paroxysms of dyspnœa occur at times so violent indeed that with each attack the patient is thought to be dying, which finally does occur in one of the attacks. Such attacks may be due to mechanical causes (acute miliary tuberculosis, &c.), but are of interest in connection with anaphylactic death.

The Sensorium.

In a certain rather small proportion of deaths, delirium and even mania may occur, due no doubt to cerebral irritation, poisoning, or, in some instances, to actual involvement of the brain or its membranes. This condition is more likely to occur when some sudden fatal complication sets in than when asthenia is the cause of death. On the other hand, unconsciousness may exist for two, three or more hours, or even seven days before death, as in one of my

patients. Another gave birth to a child during the coma which preceded death. Landis has called attention to the fact that in patients who are free from bodily pain, unconsciousness may set in some hours before death.

Death at Home or Abroad.

Among the Sanitarium patients, it was attempted to discover whether or not patients who died from asthenia were more likely to die at home than away, and whether this held true for hæmoptysis. *A priori,* we would think that among the deaths from asthenia more would occur at home, which is what actually happens (55 per cent. in 222 deaths), while among the deaths from hæmoptysis, which more often occur suddenly, more would occur away from home, which, too, agrees with the actual facts (66 per cent. of 56 deaths). The remaining figures are too small for any conclusions to be drawn.

General Summary.

Of the 1,337 deaths, 959 occurred among patients of the Adirondack Cottage Sanitarium. Of these, 44 occurred during residence, and 915 after discharge. Of the whole 959 patients, only 5.6 per cent., or 1/18 of the entire number, died from causes other than tuberculosis. Among these 959 deaths, 385 were certified as pulmonary tuberculosis, and no further data were obtainable. Inasmuch as many of these deaths took place at a time when great pressure was brought to bear upon the physician to certify deaths from tuberculosis as due to other causes, it seems very probable that the deaths certified as tuberculosis were most probably tuberculosis. The 54 deaths from causes other than tuberculosis have all been very carefully checked up, and it seems very unlikely that any of these were due to tuberculosis as

TABLE No. 1.—SUMMARY OF 1,337 DEATHS.

(A.) Deaths occurring among 959 Patients of the Adirondack Cottage Sanitarium.

	Total No.	Total Percentage *				Male.	Female.	During Residence.	Post Discharge.
	959	...	...	...	..	517	442	44	915
(*A*) Associated with Marked Functional Changes ... (383)	...	66.72	...	...	...				
I.—Asthenia	332	...	.	..	57.84	163	169	12	320
II.—Asphyxia	21	...	...	...	3.66	14	7	0	21
III.—Syncope	30	...	...	...	5.22	15	15	3	27
(*B*) Associated with Pronounced Pathological Changes (191)	...	33.27	...	...	...				
I.—General Miliary Tuberculosis	15	...	2.61	...	...	6	9	3	12
II.—Pulmonary Complications ... ... (95)		...	16.55	...	...				
Hemoptysis	82	...	...	...	14.29	61	21	6	76
Pneumothorax	3	...	..	...	.52	1	2	1	2
Pyopneumothorax	2	..	...	...	.33	1	1	1	1
Lobar Pneumonia	6	...	...	...	1.05	4	2	1	5
Empyæmia	1	...	...	...	.17	0	1	0	1
Pleurisy	1	...	...	...	.17	1	0	0	1
III.—Extra-Pulmonary Complications ... (81)		...	14.11	...	...				
(*a*) Tuberculous	33	...	...	5.75	..				
Meningitis	14	...	...	...	2.44	12	2	5	9
Laryngitis	2	...	...	...	.33	1	1	0	2
Enteritis	5	...	...	...	.87	2	3	1	4
Nephritis	5	...	...	...	.87	3	2	1	4
Peritonitis	1	...	...	...	.17	0	1	0	1
Addison's Disease	3	...	...	...	.52	1	2	1	2
Intestinal Obstruction	1	...	...	...	.17	1	0	0	1
Spondylitis	1	...	...	...	.17	0	1	0	1
Coxitis	1	...	...	...	.17	1	0	0	1

(*b*) Non-Tuberculous	48	...	...	8.36	...				
Thrombosis Pulmonum	1	...	...	...	.17	1	0	0	1
Embolus Pulmonum	1	...	...	..	.17	0	1	0	1
Heart Disease	4	...	...	...	.7	2	2	0	4
Nephritis	10	...	...	...	1.74	9	1	1	9
Cancer	2	...	...	...	.33	1	1	0	2
Accident	5	..	...	...	.87	3	2	1	4
Suicide	3	...	...	...	.52	2	1	0	3
Appendicitis	5	...	...	...	.87	3	2	0	5
Peritonitis (Appendix)	1	...	...	...	.17	0	1	0	1
Intestinal Obstruction	1	...	...	...	.17	1	0	0	1
Typhoid Fever	2	...	.	...	.33	1	1	0	2
Lymphatic Lukæmia	2	...	...	...	.33	2	0	0	2
Pyæmia	1	...	...	...	.17	1	0	1	0
Alcoholism	1	...	...	...	.17	1	0	0	1
Eclampsia	1	...	...	...	.17	0	1	0	1
Uterine Hem. (Abortion)	1	...	...	...	.17	0	1	0	1
Sunstroke	1	...	...	...	.17	1	0	0	1
Erysipelas	1	...	...	.	.17	1	0	0	1
Cerebral Abscess	1	...	...	...	.17	1	0	0	1
Sinus Thrombosis	1	...	...	...	.17	1	0	0	1
Senile Dementia	1	...	...	...	.17	1	0	0	1
Meningitis	2	...	...	...	.33	1	1	0	2
(*c*) Pulmonary Tuberculosis ... ... (No further data obtainable)	385	...	...	...	...	197	188	6	379

* These percentages relate only to Divisions *A* and *B*. Division *C* has been excluded.

a primary cause. Among the 574 cases about which full data were obtainable, 383 were associated with marked functional changes, the vast majority being due to asthenia (332) and relatively few to asphyxia (21) or syncope (30). Possibly asthenia occurred slightly more frequently among the females and asphyxia considerably more among the males.

Only one half as many deaths were associated with pronounced pathological changes, and of these the great majority died from some pulmonary complication, hæmoptysis causing the largest number—82 out of 95. Fifteen deaths occurred from general miliary tuberculosis, probably too small a number. Extra pulmonary complications claimed 81; 33 of these were tuberculosis, of which meningitis was by far the largest factor (14); 48 were from non-tuberculous complications, of which nephritis was by far the largest figure. Full details with the percentages relating thereto can be found in Table 1.

Secondary Infection and Intercurrent Disease.

A point that suggests itself in a study of the cause of death in a chronic disease like pulmonary tuberculosis is whether or not Osler's dictum that a patient rarely dies of the disease from which he suffers holds true. The study of the blood in far advanced pulmonary tuberculosis, and of the organs at autopsy yields no definite evidence that any large proportion of these patients die from acute terminal infections. On the other hand, only 78 (8 per cent.) of 959 patients whose cause of death is known, died from causes other than tuberculosis. Among these 78 patients, 10 died of nephritis, 6 of lobar pneumonia, 5 of appendicitis, 8 of violent death (3 committed suicide, 2 were murdered), 4 of heart disease, 2 each of carcinoma (stomach, intestine), lym-

phatic leukæmia, meningitis, surgical shock, typhoid fever, and one each from abortion (hæmorrhage), alcoholism, brain abscess, diphtheria, drowned, erysipelas, eclampsia, intestinal obstruction following operation for gastric ulcer, malaria (?), miscarriage and pneumonia, peritonitis, pulmonary embolus, pulmonary thrombus, pyæmia, senile dementia, sunstroke. It should be noted that while 11 died of nephritis, only 6 out of 959 patients died from lobar pneumonia. Of them, two were in good health at onset of pneumonia, 2 had chronic pulmonary tuberculosis, and 1 was comparatively well. All belonged to the moderately advanced stage.

Asthenia.

It is not purposed to describe in detail the last days of life of the tuberculous patient, days which seem interminable and are only too well known. In all, 332 patients, 58 per cent. (163 males and 169 females) presented asthenia as the most marked symptom before death. A list of the cases with clinical complications among these patients (see later) includes 45 per cent. of the men and 37 per cent. of the women. It is of interest to note that 28 patients died from asthenia following hæmoptysis, of whom 19 were men. Immediate death from hæmoptysis occurred in 82 patients. Another point of interest is the occurrence of the symptoms of enteritis in 13 women and in only 5 men. Symptoms of nephritis were present in 14 patients (9 men, 5 women).

Asphyxia.

This symptom was described as the most marked cause of death in 21 cases (14 men, 7 women), but was associated in one case with asthenia, in another with hæmoptysis and with syncope in four.

General Miliary Tuberculosis.

This pathological condition was diagnosed 15 times (6 males, 9 females), but was in all probability more frequently present.

Pulmonary Tuberculosis.

Pulmonary tuberculosis was stated as the only cause of death in 385 instances (197 men, 188 women). Among the men 12 per cent. had complications (5 laryngitis, 3 "pneumonia," 6 enteritis, 4 nephritis, 1 delirium tremens, &c.), and among the women 9 per cent. (3 laryngitis, 2 enteritis, 2 nephritis, 1 chronic alcoholism, &c.). Unquestionably a large proportion of these died really of asthenia.

Death from Hæmoptysis.

The cause of death in hæmoptysis varies with the stage of the disease. Profuse sudden hæmoptysis in the earlier stages is an unusual cause of death which, when it occurs, is brought about more often by suffocation. In the late stages of pulmonary tuberculosis, not only are the respiratory muscles weak, but if fibrosis has occurred the respiratory excursion of the chest is limited, the pulmonary surface available for aeration of the blood reduced, and the actual volume of the blood lessened. These factors produce death more readily from loss of blood, from suffocation from the fixation of the chest with inability to cough up even a small quantity of blood, and from flooding of the small remaining functional pulmonary area necessary for aeration. Small hæmoptyses in the late stages may thus lead to fatal results.

As you are well aware, fatal hæmoptyses are in practically every instance due to the rupture of an aneurism on one of the terminal branches of the pulmonary artery. The situation of the aneurism and the size of the rupture play important

parts in the mode of death. An aneurism in a large cavity may rupture and produce sudden death from internal hæmorrhage without hæmoptysis. It is of interest to note here that hæmothorax is excessively rare in pulmonary tuberculosis uncomplicated by pleurisy, and that fatal hæmorrhage accompanying the sudden onset of pneumothorax is unknown.

Death has proceeded from hæmorrhage due to rupture of the azygos vein into the right pleura during a fit of coughing (Morgagni).

Death from hæmoptysis occurs usually during a violent struggle to get breath, but the air passages may be so slowly filled that the breathing becomes shallower and quieter, until the patient passes the Stygian flood in the arms of Morpheus. In one case similar to this, the patient had a pyopneumothorax on the left side, a small cavity the size of an English walnut in the upper part of the right upper lobe. This cavity emptied at its lowest part into a bronchus and contained on one of its walls a small pea-sized ruptured aneurism, from which the blood gradually filled the bronchi until the patient quietly ceased breathing.

It is difficult to conceive how air gains entrance into the pulmonary vessels in such quantity as to cause death before a fatal issue ensues from hæmorrhage, but apparently a few cases have been reported (Dunin).

There are other forms of death which probably occur in hæmoptysis. It is, I believe, a well authenticated fact that in rare instances death from drowning takes place without any water reaching the lungs. One explanation of this fact is that a reflex inhibition is set up in the larynx through the superior laryngeal nerve, which stops respiration. This may occur in hæmoptysis.

Death from asthenia due to loss of blood and an inter-

current broncho-pneumonia, due either to the tubercle bacillus or other infecting organism, occurs in about one-fourth of all deaths associated with hæmoptysis (28 in 101). Hæmoptysis in these cases is often only a symptom of the acute pulmonary involvement. The patient has repeated hæmoptyses, high temperature, rapid pulse, and dies finally from asthenia.

The deaths from asthenia and hæmoptysis have been plotted to show the relation of the actual number of deaths occurring among the males and females by semi-decades. They are shown in Figures 1 and 2. The deaths from

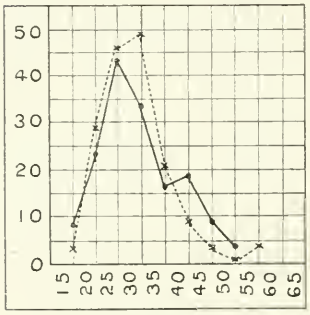


FIG. 1.—ASTHENIA.

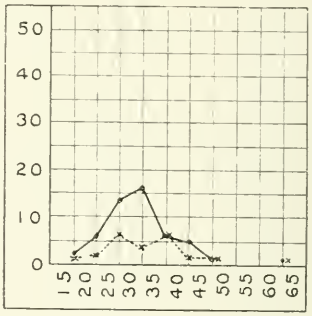


FIG. 2.—HEMOPTYSIS.

asthenia occurred slightly more frequently among the women in the earlier years and less frequently after forty. Hæmoptysis occurred much more frequently among the men up to thirty-five, and possibly a trifle more frequently after this age.

PNEUMOTHORAX.

Death from pneumothorax may be either immediate or remote. When death follows at once the signs are usually those of shock, collapse or dyspnœa, due to insufficient aeration of the blood brought about by extensive disease of the other lung or embarrassment of the heart, which

becomes unable to function sufficiently. When the pneumothorax has an insidious onset (silent pneumothorax) the fatal termination by asthenia may be hastened. The supervention of pyo-pneumothorax hastens the termination by asthenia, and a valve-like action of the two layers of pleura may produce such positive intra-thoracic pressure that fatal dyspnœa and shock may occur.

Gangrene.

Gangrene as a cause of death is exceedingly rare. No case occurred in my series, but Flint had one such case, and several others have been reported. The actual cause of death may be hæmoptysis or asthenia.

Death in pulmonary tuberculosis from pleurisy with effusion, generalized subcutaneous emphysema and empyema are rare.

Causes of Death arising outside the Lungs.

Death due to extra-pulmonary causes occurred in 111 cases, 12 per cent., and excluding tuberculous complications in 78, 8 per cent. Here, too, asthenia may be said to be a not infrequent cause of death, but the various pathological changes are so often so emphasized as to lead many to state them as the cause of death.

Among the various tuberculous complications may be mentioned meningitis (14, 12 males), nephritis (5), and Addison's disease (3). Among the various extra-pulmonary, non-tuberculous complications were nephritis (10, acute 3, chronic 6, all males), syncope (30), pulmonary thrombosis (1), pulmonary embolism (1), cancer (stomach 1, intestine 1), accidents (5), murdered (2), suicide (2), appendicitis (5), typhoid fever (2), lymphatic leukæmia (2), meningitis (2), &c.

Tuberculosis may be associated with a fatal non-tubercu-

lous involvement of the brain. Tuberculous laryngitis, when pronounced, produces death usually by asthenia due largely to dysphagia; rarely is death caused by œdema of the glottis. Death due to cardiac inhibition by irritation of a hypersensitive superior laryngeal nerve by a morsel of bread, has been described. Tuberculous ulceration of the tongue and pharynx, as well as stomatitis, hasten death by asthenia on account of the dysphagia. Death from hæmatemesis from a tuberculous ulcer has occurred, and several deaths from hæmorrhage in tuberculous enteritis have been reported. Perforation of a tuberculous gastric ulcer must be exceedingly rare; perforation of an ordinary round ulcer, occurring in a patient with pulmonary tuberculosis, is less rare. Perforation of a tuberculous ulcer of the intestines is not very rare.

Purpura hæmorrhagica with hæmorrhages from the nose and intestine may hasten death. Tuberculous meningitis was the cause of death in only 1 to 2 per cent. of these cases. It is very interesting that amyloid degeneration was not mentioned in any of these cases.

Syncope.

Syncope was given as a cause of death in 30 patients (3 per cent.). The cause of this syncope has been attributed to a reflex cardiac inhibition, to bulbar anæmia, or to a fatty myocardium. More probably cerebral anæmia and cardiac degeneration act simultaneously to bring about this syncope.

Death occurring in the Adirondack Cottage Sanitarium.

It is of some interest to glance over the 44 deaths that have occurred among the 3,300 patients during their residence at the Adirondack Cottage Sanitarium. Of these

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TABLE No. 2.

(B.) Deaths occurring among 378 Patients in Saranac Lake Village.

(Never Patients in Adirondack Cottage Sanitarium.)

	No.		Percentage.			Male.	Female.
		378				254	124
(*A*) Associated with Marked Functional Changes	260		68.8	...	...		
I.—Asthenia		256	...	...	... 67.7	159	97
II.—Asphyxia		4	...	...	... 1.0	2	2
(*B*) Associated with Pronounced Pathological Changes	118		31.2	..	.. ...		
I.—General Miliary Tuberculosis		14	...	3.7	... 3.7	12	2
II.—Pulmonary Complications		(58)	..	15.3	... ...		
Hemoptysis		48	..	...	... 12.6	41	7
Pneumothorax		8	..	.	.. 2.1	6	2
Lobar Pneumonia		1	..	...	2	0	1
Pleurisy		1	...	...	.. .2	0	1
III.—Extra Pulmonary Complications		(46)	...	12	.. ...		
(*a*) Tuberculous		38	..	...	10 ...		
Meningitis		22	...	..	... 5.8	18	4
Laryngitis		10	...	...	.. 2.6	6	4
Enteritis		6	...	...	... 1.5	2	4
(*b*) Non-Tuberculous		8	...	...	2.1 ...		
Nephritis		1	...	...	2	1	0
Typhoid Fever		1	...	...	2	1	0
Delirium Tremens		1	...	...	2	1	0
Diabetes		2	...	..	. . .5	2	0
Gastric Ulcer		1	...	...	2	1	0
Abscess		2	...	...	.. .5	2	0

44, 30 died with signs of pulmonary disease (27 per cent. of the 44 with asthenia, 14 per cent. with hæmoptysis, 7 per cent. with syncope); 8 died of extra-pulmonary tuberculous complications (11 per cent. of meningitis); 6 of non-tuberculous diseases (1 who died from lobar pneumonia).

Deaths among the Non-tuberculous Patients.

The deaths among the non-tuberculous patients admitted to the Institution number 11, of which 3 were due to nephritis, 2 to endocarditis, one each to Hodgkin's disease, chronic entero-colitis, amyloid degeneration and anasarca (probably blastomycosis) and suicide.

Deaths occurring among Patients in Saranac Lake Village.

The figures relating to the 378 patients who died at Saranac Lake from pulmonary tuberculosis show that 256 (68 per cent.) died from asthenia, 4 from asphyxia, 14 (4 per cent.) from general miliary tuberculosis, 48 (13 per cent.) from hæmoptysis (41 males), 8 (2 per cent.) from pneumothorax, 22 (6 per cent.) from meningitis (18 males), 10 (3 per cent.) laryngitis, &c. (See Table 2.)

DISCUSSION.

Dr. R. M. Landis (Philadelphia): A few years ago I made a study of this subject, considering only those cases which died under observation at the Phipp's Institute and which came to autopsy, in all about 175. In this number there were some causes of death which Dr. Brown has not mentioned. I found that practically even more cases than he reported died of general asthenia, probably 75 per cent., and that this was by far the commonest cause of death. Three died as the result of intestinal hæmorrhage. Only recently one of my assistants went over the autopsy records for the purpose of ascertaining the frequency of intestinal perforation and found 13 instances out of 600, about 2 per cent.: this seems to be about the usual

frequency. I do not quite understand the cause of death referred to as asphyxia. Except those cases which occasionally died from insufflation of blood into the bronchi, so far as my observations go, death from asphyxia never occurred. In monkeys where both lungs may become solid it has been noted that death may occur purely from mechanical causes. Only recently I saw a case in which one lung was diseased from apex to base with scarcely any remnants of vesicular tissue left, the lung on the opposite side was densely infiltrated in its upper half, and the lower half, so far as gross appearances were concerned, seemed to be all that the individual had left to breathe with. The individual seems to be able to go on with a small amount of lung tissue for a variable length of time, but just how far the process can extend and yet carry on the function of life I am unable to say. An interesting point to me is the infrequency with which the disease is terminated as the result of intestinal lesions.

Dr. GORDON WILSON: In our figures I think we found a trifle over 2 per cent. of sudden deaths from hæmorrhage in our 400 cases. I was interested in the figures showing the frequency of the deaths from hæmorrhage in men and women. We found in 1,000 cases of patients in the hospital that the percentage of the histories of hæmoptysis before admission or during admission was in women 10-20 per cent. less than in the males, and by hæmoptysis I mean any blood, whether a distinct hæmorrhage or blood tinged sputum. But of the large sized hæmorrhages causing immediate death, we only found a little above 2 per cent. in all our cases.

Dr. C. L. MINOR: Dr. Brown's statistics show that he has to depend upon the reports of various doctors with regard to the cause of death. That could not, of course, be helped; but it seems to me to depreciate his results when you recognize the fact that the cause of death in any one case may be stated quite differently by different physicians. I do not quite understand the term asphyxia as a cause of death in these cases. With one single exception I have not seen this method of death. Dr. Brown speaks also of pressure of calcareous glands; that is something I have not seen. I have seen one case where after a relatively small hæmorrhage there was an acute dissemination, and in that case asphyxia of the patient by filling up the whole area of the lung rapidly with miliary tubercles.

Dr. J. A. MILLER: I would like to ask Dr. Brown whether he himself thinks statistics gathered in this way are reliable. Not only do they consists of facts obtained from physicians of whom he can know comparatively little, but even in cases where he might be very sure of the source of information error may creep in. It seems to me that the only accurate basis upon which to tabulate the cause of death is the autopsy findings. In my experience the great majority of cases who have died under my care I have not seen for twenty-four or

forty-eight hours, or even four or five days previous to their death, and I should feel rather loath to put down in black and white what I thought to be the exact cause of the termination without an autopsy.

Dr. J. H. LOWMAN (Cleveland, Ohio): I would like to know in deaths from tuberculosis whether the heart or the respiration ceases first. Very rarely have I seen a Cheyne-Stokes respiration in death from tuberculosis; it is usually the heart that seems to stop first. Recently I saw interrupted respiration develop three days before death. Usually death follows the prolonged effects of the poisoning on the heart, and the respirations become short and rapid in consequence of the enfeebled circulation. That the respiration centre should remain so resisting has an interest.

Dr. H. M. BRACKEN: The question as to whether vital statistics can be made really worth while is of great interest to me. To make up statistics is one thing, to say they are of any value is another thing entirely. The present discussion shows how difficult it is to make up statistics. Statistics such as Dr. Brown has given are most valuable, coming from those who do not go into details too clearly as to the causes of death. In making up statistics I have often found the greatest difficulty in dealing with hospital records. These use both the clinical and pathological data. Dr. Brown, I understand, has given us the clinical cause of death. A short time ago an unsatisfactory cause of death was sent to me, and I wrote back to the superintendent of the hospital for more particulars and he sent me the report of the pathologist, which gave seven causes of death.

Dr. C. L. MINOR: Might I ask Dr. Bracken if he does not consider asthenia a common cause of death in tuberculosis?

Dr. J. H. ELLIOTT: A number of points have been brought out which interest me. One is the difference in the figures which Dr. Brown has given of pneumothorax amongst those reported by various physicians in general practice and those in Saranac. It is noticeable that very few of the outside physicians give this as the cause of death, while at Saranac it is frequently reported. This seems to be one condition which is very frequently overlooked, and it may be true that in many of the other cases of death which have been reported the cause given is not absolutely accurate. I have seen three cases within the last year where there was a condition of pneumothorax or pyopneumathorax in which the condition was not diagnosed by the physicians, and here death would be attributed to asthenia though the pyopneumothorax was the contributing cause.

Dr. JOHN M. SWAN: I have seen one patient with tuberculosis who died of asphyxia. The fatal termination in this case occurred as the result of the extensive plastic pleurisy. I was not able to

determine clinically whether there was an underlying massive tuberculous pneumonia. There was no autopsy. The patient actually died for want of air, and was conscious almost up to the moment of his death.

Dr. Lawrason Brown: In my paper I stated that these observations were purely clinical; they are not pathological, but even when you do perform *post mortems* you cannot always find out the cause of death. In fact, it may happen that you can determine the cause of death just as well before as after the *post mortem*. In the patient who died suddenly and on whom we performed an autopsy, we could not, after the autopsy, give any cause of death except asthenia. We knew, in reality, as much about the cause of death before the autopsy as after it. With regard to the definition of the term asthenia, I classified all cases as dying of asthenia when they sank gradually, became weaker and weaker until every organ and system seemed to give out. In reality they gradually faded away. In regard to asphyxia, I classified those cases under this term where the patients had been in good or fair condition, not gradually weakened, who became markedly short of breath, cyanotic, and sank and died with pronounced symptoms of cyanosis and dyspnœa. To give you an idea of how I have used the term syncope, I would relate the following case: An attending physician of a sanatorium went to see a former patient, a young woman. While calling at the house she went out on the porch in fairly good condition, but suddenly died from no apparent cause so far as he could see. I classified this case under syncope, as it seemed to me a question of heart failure. There may be a number of other explanations, but I am giving you these because they are the clinical definitions which I have used. With regard to the statistics, I have merely given you those which I had, together with the data on which they are based, and you can form your own opinion as to their value. With regard to not having seen the patient for four or five days before death, I do not believe that in the majority of these cases it makes any great difference in the classification of the cause of death. For instance, if we make inquiries and find that the patient has been getting gradually weaker and weaker and his friends tell us that he went to sleep and did not waken, then I think we could say definitely that the patient died of asthenia. With regard to the difference in the figures relating to pneumothorax in health resorts and the patients we had in the Sanitarium, I think pneumothorax occurs more frequently in acutely advancing cases which we do not admit, and which remain in Saranac Lake village. Of course we know this complication is easily overlooked. It must be remarked, however, that pneumothorax may be diagnosed when it is not present. These statistics, of course, are not final; they represent a study of the causes of death of the cases we have treated.

Dr. C. L. Minor: I would like to ask what has been Dr. Brown's experience of the condition of the kidneys in these cases?

Dr. Lawrason Brown: Among the cases under the head of Extra Pulmonary Complications I divided nephritis into tuberculous and non-tuberculous. Tuberculous nephritis was given as the cause of death in 0.87 per cent., and non-tuberculous nephritis was stated to be the cause of death in 1.7 per cent. Addison's disease and intestinal obstruction and other conditions of this nature I have not had time to-day to go into.

Dr. Lawrason Brown: It is an important thing to realize that patients with an acute condition have little chance of being with the other patients who may not even know that any new patients have arrived; hence when they die, even if they know of the death, it makes very little difference, as the patient, so to speak, was not one of them. It is different in the case of a patient who has been in the institution for some time and has been much with the other patients; they grow fond of him and when he dies it makes a tremendous difference to them.

THE CLASS METHOD IN THE HOME TREATMENT OF TUBERCULOSIS, AND WHAT IT HAS ACCOMPLISHED.

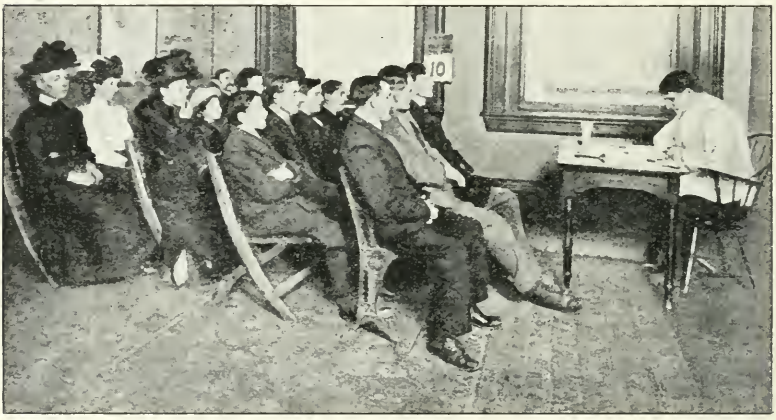
BY JOSEPH H. PRATT, M.D.
BOSTON.

In the development of the class method I received much help and inspiration from four men. Three of these men are members of this Association, and are present to-day. To our honoured President I owe the abiding conviction that in this fight against tuberculosis we should make the best possible use of the facilities at hand. From Dr. Charles L. Minor I learned that the treatment of tuberculous patients outside of a sanatorium could be carefully supervised and that excellent results could be obtained. For many details connected with the study of tuberculosis and the sanatorium treatment I was indebted to Dr. Lawrason Brown. By Dr. Charles S. Millet I was taught the importance of keeping consumptives in the open air during the night as well as during the day.

With my plans definitely formulated, I tried to induce the Boston Association for the Relief and Control of Tuberculosis to establish a class, but it was unwilling to make the experiment. Seeking aid in other quarters without success, I finally turned to Dr. Elwood Worcester, the rector of Emmanuel Church. At that time there was not a sanatorium or hospital for the poor consumptive with advanced disease in Massachusetts, and many patients in the incipient stage could not go to the State sanatorium for lack of money.

The work of saving the lives of poor consumptives, and of restoring them to health and happiness, seemed to me a good form of practical religion, and I thought that the Churches, if their efforts were well directed, could do an immense amount of good in the campaign against tuberculosis, and I think so still.

I was a stranger to Dr. Worcester, but he listened to my plea. I was able to convince him that the method of



A weekly meeting of the Buffalo Tuberculosis Class. (Buffalo Association for the Relief and Control of Tuberculosis.)

home treatment was worthy of a trial. Without any delay he gave me the financial assistance needed.

Throughout the entire six years the expenses have been met by Dr. Worcester's parish. In the management of the class he gave me a free hand. There has been no connection between the class work and the so-called "Emmanuel Movement," for the moral treatment of nervous disorders. Although the success of the Church tuberculosis class was one of the things which inspired Dr. Worcester, in his attempt to bring religion and medicine into closer relation.

The statement made by Dr. Knopf* in his book on tuberculosis that the doctors of divinity went among our patients and inspired them with hope and comfort is not correct. But if the clergymen of the parish had visited the class members in their homes or had worked with us at the weekly meeting, I do not doubt that marked benefit would have resulted.

The details of the class method have been fully described in former papers. From July 1, 1905, to April 1, 1911, the number of patients treated in the class was 117. The class membership on the latter date was sixteen, making a total of 133. The number who recovered was sixty-four. Of these sixty were well and working on April 1. Among the sixty-four who left the class during the past six years with the disease arrested and wage-earning power restored only two deaths have occurred.

The first of these fatal cases was probably due to acute lobar pneumonia. The patient, John H., entered the class July 25, 1905. He was 22 years of age and a brass finisher by trade. For three months he has been troubled with a cough and had raised bloody sputum. There were physical signs in the right lung of incipient phthisis. His weight on admission was 131 lb. In the spring of 1906 he was allowed to take considerable exercise as we wished to get him back to work as soon as possible.

But the disease became active again, the result, I believe, of over-exertion. Tubercle bacilli reappeared in the sputum, and he spat up blood quite frequently. He recovered, however, and was graduated July 20, 1906, with wage-earning power restored. At that time he felt well and weighed 145 lb. In June, 1909, he wrote me that he was feeling "extra good." His weight was 141 lb., and he had no

* Knopf, "Tuberculosis," New York, 1909, p. 303.

cough. He was earning $2.50 a day, which was equal to the wages received before his illness.

He remained well up to May 7, 1910. On that day he felt slightly indisposed. Death occurred two days later. His aunt said that shortness of breath was the chief symptom. He was seen but once by a physician, who gave phthisis as the cause of death. Although I wrote to this physician I have been unable to learn upon what facts he based this diagnosis.

The other fatal case among our graduates was also one of incipient phthisis when admitted to the class. This patient, Mabel P., aged 24, entered the class May 16, 1906, and was graduated with the disease arrested in October, 1906. She then returned to her home in Nova Scotia. In September, 1908, we learned that she was married and had a baby several months old. She reported that she was well, but had lost considerable weight. We never heard from her directly after that time, but a rumour reached us that she had consumption and was very ill. Her death occurred during the summer of 1910.

Graduates are urged to report as soon as any symptoms develop or if their health is in any way impaired. As soon as a relapse occurs provision is made for re-admission into the class. Six of our members have taken this "graduate course" and regained for a second time their health and wage-earning power. All of these are now well and working. On April 1 there were two graduates with active disease. One who had nobody to care for her at home was placed in the House of the Good Samaritan, and the other who married after leaving the class, was being treated by a family practitioner as she was able to pay.

Of the cases in which the disease was arrested or apparently cured, twenty-five were in the first stage of the disease,

twenty-six in the second stage, and ten in the third stage. There have been eighteen deaths among active members, all of which occurred in patients who, on admission, were in the third stage of the disease. Twelve of our members were sent to sanatoria or other institutions. Eleven withdrew from the class owing to their removal from Boston. Eight of these were improved and three unimproved. Twelve members were discharged because of failure to follow the rules. At the time these disobedient patients left the class all were improved, and a number considered themselves well. The most frequent cause of insubordination has been the false idea entertained by the patient that he had recovered from the disease and that attention to the details of the treatment was no longer necessary.

The sociological problems connected with work are scarcely less important than the medical problems and usually more difficult to solve. We have co-operated with the Social Service Departments of the Emmanuel Church and the Massachusetts General Hospital and with the charity organizations of Boston and neighbouring cities and towns. During the past year we have furnished no financial assistance to any members. When money for food, coal, or other necessities have been needed we have obtained them from existing agencies or the social service worker in the Church has secured aid for us. The expense of maintaining the class from July, 1905, to April, 1911, was $7,839.00.

Membership in the class has often proved to be of moral and mental benefit. Some young fellows with bad traits and tendencies have developed into worthy citizens. The brother of one of our graduates wrote me that the class had done wonders for Thomas. He was a changed man.

Much of the success of the Emmanuel Church Class is due to the work of a succession of devoted and capable

friendly visitors—Miss Isabel Strong, Mrs. Teus Oreon, and Miss June K. Hills.

The home treatment of tuberculosis is a difficult matter. The supervision of a patient in his home is rarely as thorough as in a sanatorium. The excellent results we have obtained would have been impossible if we had not insisted upon rest in bed or in a reclining chair throughout the entire day, except when taking the prescribed amount of exercise. Until the activity of the disease was arrested no exercise was permitted, except the weekly or fortnightly attendance at the class meeting. Later increasing amounts of exercise were given, beginning with a daily walk of five minutes. A detailed account of the employment of rest and exercise in the treatment of my tuberculous patients has recently been published.* Patients retain membership in the class until recovery or death occurs.

With the aid of other members of the family the class system has enabled us to secure better supervision than is obtained in some sanatoriums. Who can doubt that a patient at rest out of doors in his own home will make surer progress towards recovery than if he be in a sanatorium where he is allowed to roam about at will?

Opponents of the class method have repeatedly stated that our good results have been due to the "personality" of the medical director, but is it less essential for the physician in charge of a tuberculosis class to have the proper personality than the resident physician of a sanatorium? Could a physician, lacking in the intangible something called "personality," to which these critics refer, have success in the treatment of tuberculosis by any method? Those who attribute the success of the Emmanuel Church

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* Pratt. *Journal of the Outdoor Life*, 1911, viii., p. 153.

Tuberculosis Class not to the methods of supervision and treatment, but to my "personality," have been well answered by Dr. C. S. Millet in the discussion of a paper I read before the Massachusetts Medical Society in 1907. "If there is anything," he said, "in taking a heartfelt interest in your patient, in paying attention to detail and insisting upon entire obedience on the part of the one most interested, which the rest of us cannot imitate, then, of course, Dr. Pratt's personality is certainly the most important factor in the kind of work he has originated. Otherwise there is nothing about this work that any man here cannot do."

During the past five years many classes have been started. A large majority of these have been failures, but I do not know of any class which has not proved a success in which our methods have been exactly followed. I have had six assistant physicians in the class during the past six years, and I have failed to see that my success was greater than theirs. During the past year the medical work has been almost entirely in the hands of Dr. Lesley H. Spooner, and the results obtained are as good as those of former years.

In 1906 my assistant in the Emmanuel Church Tuberculosis Class, Dr. N. K. Wood, established the Arlington Street Church Class. The friendly visitor for the entire five years of its existence has been Miss Minnie Earley, who was the first patient and one of the first graduates of the Emmanuel Church Class. Although not a trained nurse, she is a thoroughly trained friendly visitor, and the success of the class has been in no small measure due to her efforts.

The number of members has been strictly limited in order that careful supervision might be possible, and there has

been the same insistence on rest out of doors and on absolute obedience that has characterized the work of the original class. The results obtained have been equally good.

A tuberculosis clinic has been maintained by the Social Service Department of the Massachusetts General Hospital since the fall of 1905. At that time a tuberculosis class for the treatment of patients living in the suburbs of Boston was organized by Dr. Hawes, who was my first assistant in the Emmanuel Church Class. Changes were made in the class method as employed in the Emmanuel Church Class, so that it soon ceased to be a class in the sense in which I have used the term. Instead of the weekly class meeting,* which is the distinctive feature of my class method, a "weekly clinic" was held. The "class idea," as Dr. J. A. Miller calls it, consists of giving a large amount of care to a small number of patients. This was disregarded. The number of patients in the class was not limited to twenty-five or less. The published statistics† show that on October 1, 1906, the membership was thirty-two, and on October 1, 1907, it was thirty-nine. During the intervening year 130 cases were treated. The statement is made in the report issued in 1908 that it usually took two to two and a-half hours to see all the patients. During the second year additional modifications were made in the method of treatment. The physicians in charge, Dr. Hawes and Dr. Floyd, no longer compelled the patients to sleep out of doors. "Whenever the patient can sleep out without hardship to himself or to others we have advised it, but have not made it a hard and fast rule."‡ They further state that

* For a description of the weekly meeting, see Pratt, *British Medical Journal*, October 10, 1908.

† Second Annual Report of the Social Service Department of the Massachusetts General Hospital, Boston, 1907, p. 20.

‡ *Ibid.*, p. 15.

"they no longer demand that a patient should take one and a-half or two quarts of milk a day, or stated amounts of olive oil." (Rules enforced in the Emmanuel Church Class.)

The rule of the Emmanuel Class that the strict rest treatment must be followed by all members was also modified after the first year. The writers of the second report express themselves as follows: "We often regret that our patients have to go back to work so soon, before we are willing to have them do so, but we have to recognize that we are often confronted by a social problem rather than a purely medical one. How long is it wise to allow a family to be supported by charity before the wage-earner is allowed to earn something for himself? This question cannot be answered by adhering to a definite rule that no one is to return to work until he has been without fever, a high pulse, and without signs of active disease in the chest for one or two months. On the whole, this does not always seem a practical solution. Before deciding such a problem as this one way or the other, we have held a conference of all the people concerned and tried to settle it as fairly as possible. It is perhaps a pessimistic view of the situation, but to us it has seemed more and more evident that it is education of all classes, stimulation of all cities, towns, and villages in the modern treatment and care of tuberculosis, and the education of the individual patient so that he will not infect others, rather than his cure, which are the issues of paramount importance in this work."

The question raised in the preceding paragraph is an important one. "How long is it wise to allow a patient to be supported by charity before the wage-earner is allowed to earn something for himself?" It seems to me that the necessity of rest in the active stage of the disease gives the

answer. To allow a patient with fever, a rapid pulse, and signs of active disease in the chest to return to work will certainly lead to disastrous results. In the vast majority of cases it will rob the consumptive of all chance of recovery, and an increasing disability will soon compel him to stop work. Then he must be cared for until his death by the community and his family supported by charity. It would be interesting if the directors of the Suburban Class would publish a detailed sociological and medical report of the outcome in those instances in which the wage-earner was allowed to work while the disease was still active.

Let me cite an illustration from our own experience. A patient, Thomas D., aged 32, a tailor by occupation, entered the Emmanuel Church Tuberculosis Class July 5, 1908. It was a second-stage case. He was allowed to return to work November 20, 1908. While in the class he had received seven dollars a week for sixteen weeks from a fraternal order. At the time he resumed work his temperature was normal, he had no cough, and felt well. His weight had increased from 136 lbs. to 155 lbs. No signs of activity were found on the physical examination. I felt that he had been too short a time under treatment, but as he had no funds I decided to try the experiment of allowing him to work. In December and January he came to the class, and reported that he was feeling well and the work did not tire him. Early in February he began to feel very tired at night. I did not see him again until the class meeting on March 5. He had stopped working a few days previously. He felt weak and discouraged. He had noticed a little blood in his sputum, his appetite was poor, and he had lost five pounds in weight. He had been working at his trade nine hours a day. There were sixty-five workmen in his room. He did not have a cent of money, and he had a wife and three children to support. The

oldest child was only six years of age. His parents were living in Italy, and his relations in this country were very poor. I believed that it was essential to support this family until the wage-earner had recovered his health. He was allowed seven dollars a week from the class fund, which at that time was unusually large. He was graduated on October 29, 1909, with the disease arrested. His weight at that time was 170 lbs. He secured a place in a new shop where there were only four other workmen. He began to work the day after graduation. He has remained well, and has been able to support his family for twenty months. No other patient in the class has ever received so much financial assistance. He was given in all $162.00. His wages since returning to work have averaged ten dollars a week, so that his earnings have already amounted to eight hundred dollars. It seems to me that the expenditure of money in this case was wise.

From the report of the Suburban Tuberculosis Class published in 1908,* and covering the preceding three years, it is seen that the character of the work done was more that of a well-organized tuberculosis dispensary than that of a tuberculosis class. During this period they had a large number of patients—"about 313 in all." Of these, 205 were under treatment for at least two months. These included cases of surgical and ocular tuberculosis in addition to cases of phthisis. Between October 1, 1908, and January 1, 1910, there were discharged thirty-four cases of pulmonary tuberculosis. Six of these were cured or arrested at the time of discharge, fourteen improved, ten not improved, and four dead. Sixteen were in the first stage of the disease, fourteen in the second stage, and four in the third.

* Third Annual Report of the Social Service Department of the Massachusetts General Hospital, Boston, 1908, p. 22.

In October, 1910, the Suburban Tuberculosis Class was reorganized as a regular department of the hospital for the administration of tuberculin and the hygienic care of all forms of tuberculosis.

In his last report issued in January, 1911, Dr. Hawes says that "tuberculosis classes will probably never play the important part in the anti-tuberculosis campaign that was at first expected." Miss Gertrude L. Farmer, of the Social Service Department of the Massachusetts General Hospital, at the recent National Conference of Charities and Corrections held in Boston, expressed herself as opposed to the class method of home treatment. Inasmuch as the Suburban Class, upon the work of which her opinion is based, followed the so-called dispensary method rather than the class method, it is wrong to condemn the class method as developed in the Emmanuel Church Class because results obtained in the Suburban Class were disappointing.

It was doubted whether the class method could be carried out in the congested districts of New York, where the housing conditions are more unfavourable for the fresh-air treatment than they are in Boston. Undeterred by many difficulties, Dr. W. L. Niles, of New York, formed the Christ Church Tuberculosis Class in that city. He was aided by a singularly efficient volunteer visitor, who not only gave her services, but raised a fund for the maintenance of the class. No more convincing demonstration of the value of the class method as an aid to the home treatment of consumption has been made. The patients were few in number, and they all lived within a short distance of each other. This made close supervision possible. For many weeks the friendly visitor made daily calls on all the members.

From November 28, 1906, to October 1, 1908, seventeen

out of nineteen members graduated, resigned, or discharged, were restored to full wage-earning power. No members failed to improve. Owing to the inability of Christ Church to furnish financial support to the class, Dr. Niles resigned, and his successor has been much hampered by lack of money.

One of the strongest and best Church classes is the St. George's Class of New York, which was organized in October, 1907. Dr. N. Gilbert Seymour and Dr. Tasker Howard are the physicians in charge. The class has attractive quarters in the parish house for its weekly meeting. A liberal supply of milk and sandwiches are served during class hours. As a result the members feel less fatigued by the meeting, and do not miss their customary afternoon nourishment. This luncheon "has also served to give the meetings a more social atmosphere, which the patients appreciate and enjoy." The directors of St. George's Class appreciate the necessity of limiting the membership in order to avoid failure in the home treatment. On this subject they write as follows: "The Church class depends for its success upon the time and care which can be bestowed on individual cases. If it outgrows these limits, it is able to do only what the district dispensaries are already efficiently doing—that is, give a certain amount of assistance, medical and sociological, to a large number of patients. To justify its separate existence the Church class must limit its membership to a number who can be cared for in every essential particular. Our experience, recently, leads us to believe that, in our class, that number should not be above fifteen patients."*

The last report was published in 1909, and covered a period of seventeen months. At that time (April, 1909) the

* Report of the St. George's Tuberculosis Class, New York, 1909. p. 9.

total membership had been twenty. Two of these had recovered, one had died, and three had been dismissed. The remaining fourteen were still under treatment. In four the disease was already arrested, six had improved, and four were unimproved.

Dr. Myer Solis-Cohen* has described the work of the tuberculosis class organized by the medical dispensary of the Hospital of the University of Pennsylvania. In this class the educational value of the weekly meeting is especially emphasized. "It is a class in fact as well as in name. The first hour is devoted to lectures or talks by the class instructor and his assistant; to lectures and talks given by the patients themselves; to a general clinical conference in which the patients' records are criticized by both the instructor and the class members, and instruction is given by both; to public investigations into cases that do poorly to determine the cause, from which lessons are drawn for the benefit of all; and to a quiz to find out what the members know and do."

Facilities for leading the out-of-door life are not furnished. Patients who could not afford to buy tents for sleeping in the open were obliged to find substitutes for them or go without. One "improvised a tent in a corner of the yard by throwing an old carpet over the side and back fence and over a clothes-line. Still another used a pole instead of a clothes-line, and a rubber sheet instead of a carpet, thereby being able to remain out in the rain. Members sleep in porches, in back kitchens, and in bedrooms with windows wide open, top and bottom."

There is no fund at the disposal of the class. There is no class purse. Supervision in the home is in the hands of volunteer friendly visitors, and the social worker of the

* *Journ. Amer. Med. Assoc.*, 1910, liv., p. 1193.

hospital investigates the financial condition of each patient and solicits aid from various sources.

The results are stated to be excellent, but no detailed report has been made.

The experiment of Dr. Solis-Cohen is an interesting one, but it does not seem possible that he will be able to equal the success of the Church classes mentioned unless more financial aid is secured for the poorer members. Patients with active pulmonary tuberculosis must be given the needed rest. Membership of a class which gives only instruction in the modern method of treatment will never cure consumptives if they are obliged to work when they should be at rest.

In 1909 a class was formed in connection with the Elmwood Presbyterian Church of Belfast, Ireland. This was the first tuberculosis class to be organized on the other side of the Atlantic.

In this class, as in the Philadelphia class just described, it seems to me that too much importance is attached to the class itself—the weekly meeting, the record books, and the home visitation of the nurse—and too little importance to the three essentials—rest, fresh air, and good food.

I will give the published record* of one of the Belfast patients :—

" Mrs. M.—Husband, labourer; five children—eldest 11, youngest 16 months. Our first visit found the patient occupying bed with husband; baby in a cradle; windows shut. Small bed was put up facing the window, and blankets provided for the patient. Husband's bed pushed on to the side of room. Baby removed to the children's room. Windows kept well open, top and bottom, in bedroom and kitchen.

* *Slainte*, Dublin, 1909, 1, p. 71.

"*Report as kept by Mrs. M.*—Sunday: Bad cough at four a.m. Warm milk at five a.m. Temperature 98°. Rose at eight. Breakfast at nine—tea, fried bread and sausages. Did some cooking. Warm milk 11.30. Dinner at one—potatoes, beef, and soup. Rest on sofa to 3.30. Warm milk at four. Little housework. Tea at six—bread four a.m. Warm milk at five a.m. Temperature 98°. Got into a separate bed; slept with windows open.

"Monday: Coughed badly before rising. Warm milk at 6.20. Rose at eight. Breakfast—tea, fried bread, poached egg. Light housework. Sat in doorway. Had cup of warm milk, 11.30. Temperature 97.8°. Dinner 1.30—bread and soup. Rested on sofa. Warm milk at four. Light housework. Porridge and milk at 6.30. Went to bed at nine. Temperature 98.6°.

"Tuesday: Good night. Windows wide open. Got up and had warm milk and egg. Some housework. Breakfast at nine—porridge and milk. Little washing. Warm milk at 11.30. Sat out of doors to 1.30. Dinner—potatoes and fish. Lay on bed all afternoon. Tea—fried bread and poached egg. Sat and rested. Temperature 97.6°. Bed at 9.30. Warm milk.

"In this case milk—one pint—is supplied daily."

Conditions in this home have been improved, but not enough has been done. If the patient has active tuberculosis, I would not expect her to recover unless a woman was secured to do the housework and to look after the children. Then the patient could rest in bed the entire day. If the housing conditions were so poor that it was impossible to place the bed out of doors, a window tent could be improvised. A more abundant and nutritious diet should be supplied. I realize that this patient was desperately poor, and that we in America have little conception of the

conditions under which many of the poor consumptives live in Europe. Nevertheless, the tubercle bacillus is no respecter of persons. If the disease is to be overcome, good food and rest are just as necessary for the very poor as for those in easier circumstances.

Recently a tuberculosis class was started in Dublin by Her Excellency the Countess of Aberdeen. One of the male graduates of our Emmanuel Church Class, now living in Ireland, has been secured as a lay-helper to give instruction in the details of the home treatment. In the report just published* of a paper read by the Registrar-General of Ireland, Sir William Thompson, it is stated that the class treatment "was being most successfully carried out by the Belfast Branch of the Women's National Health Association, and that the class in Dublin was doing good work."

Two classes have been formed in Montreal. The St. George's Class was organized in the beginning of 1909 by Dr. C. P. Howard. The second class is maintained by the Royal Edward Institute, and is under the care of Dr. E. S. Harding. A record of the organization of the St. George's Class, with an account of the methods employed and the results obtained, has already been published. To my mind, this class under the direction of Dr. Howard might well serve as a model of what a tuberculosis class should be.

According to Dr. Howard,† "the four essentials of the class treatment are (1) absolute rest in the fresh air, (2) forced feeding, (3) record books, and (4) weekly class meetings. One of our first duties is to make arrangements whereby the patient can sleep and live twenty-four hours of the day in the open air. Not only must they sleep outside, but they must spend the entire day in the fresh air, only enter-

* *Slainte*, Dublin, 1911, iii., p. 172.

† First Annual Report of the St. George's Tuberculosis Class, Montreal, 1910.

ing the house for meals and their morning bath, &c. A balcony with a good exposure is very satisfactory; but a flat roof is even more desirable, because this affords a freer circulation of air.

"Protection from the weather is secured in the former case by an awning, and in the latter by a flap tent. For the body heavy horse blankets, and for the feet soap stones, which can be heated and provided at cost price. Reclining chairs are also loaned by the class. Sleeping bags are made from heavy grey blankets to which padding is added. Protection to the head is afforded by an ordinary toque, in which an aperture is cut for the mouth and nostrils in the form of a visor. . . . The daily average of hours spent in the open air has been twenty, and this throughout the severest weather; several patients have spent twenty-two hours outside. In addition to the three meals a day, the patient takes a quart of milk and three to six raw eggs between meals. After each meal a tablespoonful of cotton seed oil is taken. . . . Attendance at the class meeting is the only exercise permitted, and is a great source of encouragement, to which the patients eagerly look forward. Here they meet and gossip over the events of the week. . . . It is of interest to note that three patients have gained from fifteen to seventeen pounds; two from seven to ten pounds; while but two have gained less than a pound. The two newest members have joined too recently to show any appreciable improvement. The maximum gain was twenty-two pounds in thirteen weeks.

"From April 16, 1909, to the same date of the current year (1910) thirty-five cases were investigated. Twelve patients were accepted. Nine hundred and thirty-five visits have been paid. Of the twelve cases, two are dead; one left town with the disease arrested; one has already returned

to light household duties; one is quite ready for work; three others will shortly return to their normal lives; two are much improved, but not yet well; and two have but recently joined the class."

Dr. Howard points out the importance of selecting "suitable" patients. By this he means patients who are still in a curable stage of the disease with some slight means of support. Until the tuberculosis classes were established in Montreal the best course open for such people was to obtain leave of absence from their employer, and with this aid they were able to make a short stay in a more or less comfortable boarding-house in some tuberculosis resort. If a patient joins a properly conducted tuberculosis class, "the same expenditure will keep him comfortably at home for a much longer period of time and in surroundings similar to those in which he will live when he is able to return to work. Moreover, not only will he be 'educated' in the process, but also the entire family, and, what is equally important, his neighbours, and even his circle of friends."

During the first year of its existence the St. George's Tuberculosis Class spent $1,180.00. This disbursement includes several articles which are now permanent assets of the class, such as chairs, blankets, awnings, fur coats, &c. We take special pride in the success achieved by this class, because the friendly visitor, Miss Florence E. Rothwell, came to Boston and worked as a volunteer in our Emmanuel Church Class. Upon her return to Montreal she faithfully followed our teachings.

A tuberculosis class was organized in the tuberculosis clinic of Bellevue Hospital, New York, by Dr. J. A. Miller, on March 1, 1909.* A second class was formed later in the

* General description and annual report of the Tuberculosis Clinic, Bellevue Hospital, New York, 1909, p. 15.

same year. One nurse gives her entire time to the class patients. Dr. Miller states "that the results have been gratifying beyond our expectations." Larger financial assistance has been given these classes than to any that have been established elsewhere. The first class opened with twelve patients. From March 1, 1909, to January 1, 1910, the total number treated was fifty-five. Only two of the thirty-two cases concerning which details are given were in the third stage. Fifty per cent. were in the incipient stage. The financial aid furnished to the class patients during this period amounted to $1,744.24. The cost of administration, including the board of twenty-five patients who attended the day-camp, was $2,872.54. The total expense was $4,616.78. The weekly cost per patient was $5.44.

"Of the thirty-two cases discharged, 81.2 per cent. were improved or better; 53.1 per cent. being either cured or their disease arrested. The cases were, of course, selected ones, but were distinctly less favourable for treatment on the average than those usually received at sanatoria, and the results are nearly if not quite as good. The day-camp has been a distinct help in the cure of these patients, twenty-five of the thirty-two having taken 'the cure' in that way during the day. The expense entailed was small compared with that of supporting a patient at a sanatorium, and, moreover, the homes are not broken up, which is an important consideration in the case of the heads of families."

The work of the tuberculosis classes in Buffalo is described as follows in the report of the Buffalo Association for the Relief and Control of Tuberculosis for 1910:—"A tuberculosis class consists of a comparatively small number of patients, usually not more than twenty, in a curable stage of the disease, who for one reason or another cannot go to a sanatorium distant from their homes. It often includes

patients waiting the two to three months to get into the State Sanatorium at Ray Brook, or returned Ray Brook patients to whom the continuation of the sanatorium treatment at home, in so far as it is possible to do so, is very essential. The class patients meet weekly for class instruction by the physician in charge. The talk given is usually brief, and on some phase of the 'cure' that they are urged to take. They are in charge of one nurse or visitor, who gives them more time and attention than the regular visiting nurse can give to the usual patient. For some tents are provided so that they may sleep outdoors. Arrangements are made to have others sleep in porches. Sanatorium chairs are provided, in which the patient takes his 'cure' during the day out of doors.

"The point is not that some patients are favoured and selected, but that the patients whose condition and surroundings are such as to require an extra amount of attention shall receive such attention by the class system. The friendly rivalry as to who can excel in the effort to get well has a splendid effect on all.

"Tuberculosis class work in Buffalo has, previous to the last summer, been under the auspices of Trinity Episcopal Church, known as the Trinity Tuberculosis Class. The Trinity Class was discontinued about the middle of last year (1909), and at the close of the day-camp season class work was assumed by the Tuberculosis Association in co-operation with the District Nursing Association, which engaged for this work Miss Mabel Jacques, of Philadelphia, who was in charge of the St. Stephen's Tuberculosis Class and of the general tuberculosis nursing work in Philadelphia. In assuming the responsibility of engaging a trained worker of special experience for the class work, the District Nursing Association is entitled to great credit, as by their action the

continuance of class work was assured and its success certain. At the present time there are two classes meeting weekly, one for adults and the Children's Fresh Air Class for anæmic, "pre-disposed," and slightly affected children. A third class for adults will soon be started."

The class method of home treatment was adopted by the Phipps Institute of Philadelphia at the time of its reorganization in 1909. Both Dr. Landis, the medical director, and Miss Sutton, the superintendent of nurses, made a personal study and investigation of the work of the Emmanuel Church Class in Boston. There is every promise that the success of the Phipps Institute Class will be great. Dr. Landis and Miss Sutton have introduced certain improvements. A permanent exhibit has been installed in the class room which illustrates the various ways of taking the rest treatment out of doors. Instruction in selecting and preparing economical and nutritious food is given to the class members, and the fireless cooker is largely employed.

The class includes several patients with far advanced phthisis who have made surprising improvement as a result of the strict rest treatment. In favourable cases less insistence is placed on rest than I consider necessary in order to secure the best results. A few of the non-febrile patients are allowed to work. The discipline and home supervision is excellent, and, as careful records are kept, the result of Dr. Landis's experiment of allowing convalescent patients more exercise will be interesting when compared with the statistics of the Emmanuel Church Class.

Dr. Landis has an excellent account of the class method in his article on tuberculosis in Hare's Modern Treatment.* He points out that patients who offer some hope of im-

* Hare's "Modern Treatment," Lea and Febiger, Philadelphia, 1910, vol. i., p. 755.

A member of the Phipps Institute Tuberculosis Class, of Philadelphia, taking the rest treatment at home in a covered balcony. A window forms the entrance to the balcony. This type of structure is much better than a roof tent or ordinary balcony.

Face p. 108.

provement should be chosen, and adds that "no patient should be taken into the class from whom we cannot exact full obedience to the rules, otherwise discipline, which is the keynote if the whole system fails."

Classes have been formed in other cities. They are scattered across the country from Portland to San Francisco. There is one even in Honolulu. This was established by the late Dr. Brinckerhoff, who from the time of the organization of the Emmanuel Church Class was one of its friends and supporters. I know that many classes exist of which I have no record, and I hope the members of this Association will aid me in preparing a complete list of all the tuberculosis classes in America and Canada.

The history of many unsuccessful ventures proves that it is not an easy task to establish a tuberculosis class that justifies its existence. The physician in charge must have a special knowledge of the diagnosis and modern treatment of pulmonary tuberculosis. He must be interested in his patients and be a good disciplinarian. Some have thought that the cure of consumption was such a simple matter that it made very little difference what sort of a doctor was in charge of a class. I know of one class that was managed by a committee of ladies. There was no physician connected with it.

The right sort of a nurse or trained friendly visitor is as essential as the right sort of a doctor, and she must be carefully trained in the details of the home treatment and the class method. It is to be hoped that the Phipps Institute will establish a training school for class nurses. At the present time it gives instruction to the medical students of the University of Pennsylvania in the class method and the home treatment of phthisis.

That an untrained volunteer visitor may do more harm

than good is clearly pointed out by Miss Jacques.* She cites the case of a friendly visitor who thought a patient under her care was able to work, so "she persuaded a friend in a neighbouring suburb to give him work which she considered light—running a lawn mower. For two days the lawn was mowed, then one day, on the car going to work, came the blow without any warning—hæmorrhage." It is evident that the class with which this young woman was connected needed not only a new friendly visitor, but a new medical director who would not place matters of vital importance in the hands of incompetent assistants. Only a physician should decide when a patient with the disease arrested is able to work.

In those classes in which the members with active disease have been allowed to work or exercise, the results have been poor, and the failure has been attributed to the class method. Unless members of a tuberculosis class make substantial improvement, and a fair proportion of them recover their wage-earning power, it is doubtful if the class will have any helpful educational value. Instead, it will impress upon its members the terror of the disease. If the infection gets a firmer hold on the members, or if slight gains are followed by exacerbations, which so frequently occur when the rest treatment is not followed, then the weekly meeting of patients doing badly with the examination of records and reports of weight lost will become positively harmful, because it will tend to depress rather than encourage the patients.

Consumptives living at home, but kept at rest out of doors, will recover in the majority of instances, if the disease is not hopelessly advanced when the treatment is begun. A tuberculosis class with its members well fed following the

* Jacques, "District Nursing *versus* Friendly Visiting," *Journal of the Outdoor Life*, 1910, vii., p. 386.

rest treatment, and provided with facilities for leading the out-of-door life in comfort, will obtain results equal to those of the sanatoriums. The class method has been tried in cold climates and in warm, in favourable climates and unfavourable ones, in congested sections of large cities and in country districts. Under these varying conditions success has been achieved where the patients have been kept at rest, where the supervision has been adequate, and where strict obedience has been enforced.

DISCUSSION.

Dr. H. R. M. Landis: I have been interested in the class method ever since it started, but it was not until a little over a year ago that I began to be directly concerned. At that time I made a trip to Boston to see the work at first hand, and left there with the impression that conducting a Class was a very simple and a very easy thing. I think I encountered the difficulty that many have, that is, that the extreme simplicity of the whole thing impresses one as easy. It was not very long, however, before I found that it was one of the most difficult things I know of, and I think failures have occurred largely because of the simplicity of the method. For instance, one class I know of was started by a clergyman with no medical training whatever; this was a failure. Another man started three classes at once. He had absolutely no training, no experience whatever. These were also failures. Just because it sounds easy does not mean that it does not require an infinite amount of work. One's enthusiasm has to be kept up, and kept up constantly; it must never flag. While the doctor can furnish the enthusiasm to these patients, and can inspire them with confidence, I believe that the success of the method depends largely on the tact, the perseverance and the character of the woman who visits the patients in their homes. As regards the position of the Class treatment as a means of combating tuberculosis, there is no question in my mind that it has its place, just as the sanatorium has, and that in certain cases it is the only available method of treating these patients. The ordinary dispensary method is, in my opinion, very limited. These classes have to be kept small because you cannot handle more than a certain number. One advantage of the Class method is that cases you arrest in their home surroundings are pretty apt to stay well. Those returning from a sanatorium will often revert to their former method of living, their excuse being that they cannot

do this or that because they do not have the facilities they had at the sanatorium. I have also employed the Class method largely for teaching methods, that is, the students attend the meetings of the Class and they visit the members in their homes. As an aid to both students and patients, I have in the classroom practically all the paraphernalia that is employed in the home treatment. The question of dietetics is also taken up. We have installed as a part of our system a fireless cooker, an ice-chest, diet charts, &c. This course was necessary, as it was found that patients would not use certain articles of food which had a very high food value (cereals, beef stews, &c.) because they take too long to cook. The nearer you approach to absolute rest the better. I have patients that are on a limited exercise, but great care must be taken. I have also established as a sort of branch of the Class a group which meets in the evening, so that patients working during the day may report. These are cases in which the disease is in a very early stage, and which it was impossible to send away. I cannot help but feel that the neglect of this method is to omit a very important part of our work in large cities. That it can be applied to every case of tuberculosis I do not believe for one instant. In some cases it is utterly impossible to treat the patient in the home; in other cases the home is all right but the finances are not. I do not know of any method which will offer a better return, provided that you realise that you cannot treat every case in the home.

Dr. C. L. MINOR: It seems to me from my point of view that the most important feature of the class method, as compared with other methods used in the past, is the personal relation of the patient and the doctor; that is the essence of the whole thing. It was for that that I found it necessary to give my patients record books and to keep in close touch with their daily lives. We know that with the ordinary dispensary it is impossible to have that personal relation between the patient and his doctor which in tuberculous cases seems to me the key-note of the whole treatment. How many times it has been said that you cannot routinely treat tuberculosis, that the doctor must come into personal contact with the soul of his patient, and how true! You are not treating just the body in tuberculosis. You can treat typhoid; and what sort of patient you have, and what his troubles and worries are, have nothing to do with the outcome of that case. When you treat tuberculosis it is an absolutely different thing; you have to treat the mind as well as the body. Now it seems to me that if the patient is going to a dispensary and getting medicine and more or less irregular advice, and then comes to Dr. Pratt's or Dr. Landis's class, that he is getting just that thing—he is getting information, he is getting enthusiasm, and he is getting to want to follow the rules of treatment. The essential thing is that a man of personality is acting directly on

that patient, and teaching him to do what is required for his health and making him want to do that thing. The personality of a good nurse also figures largely in this treatment. This method will never be able to be as useful as one would like to see it, because it is difficult to find the person with the energy, the enthusiasm and personality to do this sort of work. We know many who could not possibly conduct these classes, who could not possibly make a success of this form of treatment. It is so with many sociological movements; it is most difficult to get a leader for boys, for instance; the equipment is not much, but *the man is everything.* That is just the situation here. It may very well be that Dr. Pratt has been able to get a hold on many of his patients, and not only has he inspired them, but he has shown other men what can be done, and that this work is worth doing, is worth pushing forward. But it would be difficult to get many men like Dr. Pratt: it is hard to find the right man. But, granted you have the financial part put on a firm basis, I am sure you will be able to find the right men, and with this method, combined with a dispensary to hunt out and sort the cases, one could obtain results in our cities which without such a thing it would be very difficult to get.

Dr. J. A. MILLER: No one appreciates better than those of us who have been up against the same problems as Dr. Pratt in a large city, how much we owe to him for these suggestions. It seems to me, however, that he runs the risk of narrowing his own principles. I wish to make a stand against the statement that dispensaries are not suitable for group methods. In our dispensary we have 600 cases, 350 adults and 250 children, under observation all of the time. Of these, 35 adults and 40 children are put into classes, two for the children and four for the adults. We get results similar to those of Dr. Pratt, but I believe that this class method is essentially a part of dispensary treatment, and you have to select the kind of cases which are suitable. The physicians who work in the dispensaries must take these classes, and if they make a failure of the class, then they are no longer wanted in the dispensary. I believe that this class or group method is applicable to all dispensaries to a very large extent. And also I wish to emphasize their value for children, as they adapt themselves particularly well and it has been particularly successful with them. Our results have been very good, but at the same time I do not feel that we would be right in being too optimistic about the permanency of the results that the class method is going to give. We have discharged nearly 60 per cent. of our cases apparently cured or arrested, but now some of them are beginning to die or to relapse. And while we may be gratified, we must not, at the same time, draw too general conclusions until the cases have been followed for a longer time.

Dr. V. Y. BOWDITCH: While speaking a word of commendation

for the work done by Dr. Pratt and his colleagues, it may not be amiss to ask one or two questions which have occurred to me. Dr. Pratt uses the term "recovered." I should like to ask the exact definition of the term. Does he mean an entire return to normal conditions—no cough, no sputa, and a general state of apparent health—or does he merely mean that the patient is able to return to his daily work? Another point is in regard to the length of time he uses "rest." His ideas as expressed for keeping the patient wholly at rest are entirely against what most of us now feel are essentials in the treatment, *viz.*, a mixture of physical work and rest. If he keeps them absolutely quiet, does he not find that his patients return to their usual occupations in what may be called a "softened" condition, which is unfavourable? I should like to ask also how many years have elapsed since these favourable results have been obtained, and how lasting are they? As to the comparative benefit of this treatment at home and that to be obtained in sanatoria, I cannot be made to believe that it can be as good for patients to be treated in the dusty, smoky atmosphere of a city as in the purer air of the country. I should feel that the number of patients who could be treated in this way would be much smaller necessarily than when gathered together in a properly arranged sanatorium. Personality, doubtless, has much to do with the success of any method of treatment, and in this case to the energy and devotion of Dr. Pratt is largely due the success of the work. I regard it as one of the valuable methods among many for combating the disease, and, as in everything, a broad-minded attitude is necessary. We should encourage every method known to be of real use in the prevention of tuberculosis.

Dr. D. R. LYMAN: The class treatment has come under my observation at Waterbury, Conn. They have an A1 nurse who does perfectly splendid work, and they are getting excellent results, due largely and primarily to this personality and its continued application. A strong point of the class work is that they are able to keep these patients under observation for one, two or three years. In the class there they separate the cases, putting the advanced cases into the hospitals, others into sanatoriums, and others for home treatment. They have reports of persons with the disease arrested where they have been rejected by the sanatoria as cases they could not do anything with. We work together, and the patients I have sent back to Waterbury I have told to report to that class, and they have the advantage of having the supervision of a doctor who knows something about tuberculosis and a nurse who knows a great deal about it, to keep track of them, and it has been an excellent help in carrying out of the work of the sanatorium. You can extend the usefulness of such classes by keeping under observation in them cases which have already been treated in the hospital.

Dr. J. H. HUDDLESTON: I would like to emphasize the fact that the class such as Dr. Pratt has described and the dispensary class, ought

not to be considered as in any sense opposing each other; they are distinct agencies, both working for the common end, and appealing to distinct sets of persons. Some will attend a special class maintained by a Church or other organization, and yet cannot be induced to go to a dispensary; other persons whose associations are such that while they are unable to care for themselves during a long illness, will suffer rather than mingle with the attendants of a public dispensary in a city. There is, moreover, another set of persons among those attending the dispensary which is composed of individuals who are so ignorant, and therefore so unable to understand directions and to follow them out, that they can be handled only by the dispensary method. I would quote one example of a dispensary class with 250 cases, and say that we have repeatedly gone over that class with a pretty careful consideration of every single patient in it, in the hope of picking out patients who would be bettered by being placed in such a class as Dr. Pratt's, but we cannot find them; they are persons who would not follow such treatment, would not follow directions such as he gives, and those patients have to be cared for in a dispensary.

Dr. LAWRASON BROWN: Dr. Pratt deserves great credit for his work. He has made the dispensary treatment very different from what it was. The treatment in the dispensary, however, has been in one sense not more satisfactory than the treatment in a very great number of sanatoria, and quite recently, in some of the English journals, there have been articles on the question: "Is the sanatorium worth while?" It takes four or five years to cure tuberculosis in early cases, and every sanatorium cannot keep patients, nor will they stay that length of time. But to send a patient out with the appellation "cure" tagged to him after six months or a year is the most dangerous thing we can do. Four or five years of good, careful living are certainly necessary. I, of course, believe that the 117 patients treated by Dr. Pratt in five years are but a mere drop in the bucket. As far as I can see, in the class system three exceptional things are required. In the first place, you require an exceptional nurse; in the second, an exceptional physician; and in the third, an exceptional patient. Patients admitted to sanatoriums are not selected, so far as I know, on their mentality. If, however, you select only those patients who are going to follow out your treatment and do what you tell them, then you have ideal conditions. I tell patients that it is what is above their collar, and not what is below it, that matters as to whether or not they will get well. The question, therefore, about the practicability of the class system must be considered in each case. As far as I know, there have been mentioned about six successful classes, and I think when you analyze these you will find they are conducted by very exceptional men. There have been a large number of classes which have been failures, and it is just those which make one question whether it is worth while.

I would like to ask Dr. Pratt how long his patients remain under treatment on the average; and do I understand him to say that he has treated 117 patients in the last five years with 64 recoveries, 3 relapses and 2 deaths, with some 48 patients under treatment or discharged as unsuitable?

Dr. H. LONGSTREET TAYLOR: I have thought much of this work, and wondered if I was lax in not starting such a class; but in a small place it seemed to me that we could do as well with a thoroughly organized dispensary. We have our dispensary open every day; we have a sufficient staff of nurses to visit every family on our list at least twice a week, and I believe that we are taking just as good care of our patients—in fact, better than the ordinary physician takes of his private case to whom he cannot send the nurse to back up and enforce the directions he gives. Unless you go to the home of your patients, you do not know whether they are following out your directions or not; but these dispensary patients are taught by the nurse that goes to see them, and they have to follow out the directions. We help them with cots for outdoor sleeping, and to obey the rules for home treatment.

Dr. CLEAVELAND FLOYD: As regards the part that the tuberculosis class will play in the solution of the great problem of tuberculosis, there may be considerable difference of opinion. On account of the necessity of adequate means, and at least average intelligence, of patients so treated, only a few among the great number of consumptives can be benefited by this means. Among fifteen hundred cases of phthisis which present themselves for treatment yearly at the Boston Consumptives' Hospital, not one in fifteen could follow out the method of the tuberculosis class. Therefore to reach the real problem in tuberculosis, we shall still need the sanatorium, the hospital, and the day camp and dispensary. Certain statistics obtained in regard to patients treated by means of the day camp method have shown, in at least one instance, 50 per cent. of recoveries among all cases treated, lasting from one to three years. This, I think, speaks very well for this modified form of class treatment, which is applicable to a much larger number of patients. In order to gain results from the class treatment, only a limited number of patients who are capable of fulfilling its requirements can be treated. The larger work must be accomplished in other ways.

Dr. GORDON WILSON: Any step in advance over the dispensary system is a decided one. Some years ago I started a dispensary, and after years of hard work came to the conclusion that it was absolutely useless from the standpoint of the cure or arrest in the individual patient. It is of use in diagnosis and as a "clearing-house," but for treatment poor; and I came to the conclusion that even the smallest class was a distinct advance.

Dr. STANLEY G. MINER: In Detroit we found that so many

dispensary cases after leaving the tuberculosis hospital relapsed, and also the large majority that received the home treatment failed to continue attendance at the dispensary for various reasons and relapsed; that an investigation was made, revealing the fact that only a few continued to observe the dietetic and hygienic rules followed while under regular treatment. It was a question whether the sanatorium and dispensary were accomplishing very much good or not as educational factors. It was then suggested than an evening class be formed, so that cases which had resumed work could attend, and the patients be kept under surveillance and observation. We had the difficulty, mentioned by one of the speakers, of securing the right man and getting the co-operation of the physicians and patients; but this has been largely overcome, and although the work has been limited, the results are very satisfactory, and only about 40 per cent. of our cases in attendance have had relapses, and we hope to lower this number. While we all recognize the fallibility of statistics, nevertheless we feel these are reliable. With regard to the election of the plan of treatment accorded to our patient; some of the sanatoria heed too little the advice or the letters sent by the family physician. He should be in a better position to elect the plan of treatment, I believe, than the admitting officer in many cases. We elect one of three plans of treatment. First, the home treatment, which I think is the best plan in a certain number of cases. Next, the sanatorium treatment, which of course is the best plan in the largest number of cases, when it combines institutional discipline, climatic advantages, proper environment and medical skill. And third, the dispensary treatment, which is the only method available, unfortunately, in a certain percentage of cases. It is a serious mistake when a patient is directed to a sanatorium, and there are special reasons for a changed environment and institutional discipline, to give this patient the home method of treatment, where the same lack of surveillance and discipline exists that surrounded him at home; and this is one great picture to bear in mind in sending a patient to a sanatorium, that he receives the institutional treatment and discipline and not the environment and privileges of the home plan.

Dr. J. H. Pratt: I am sorry that I forgot to mention the important work of Dr. Miller in New York. His published results show most clearly the advantage of the class method over the ordinary dispensary treatment. Among the patients under his care in the dispensary who were treated by the class method the disease was arrested in 60 per cent., while the recoveries among the other patients who were treated in the same dispensary amounted to only 5 per cent. In New York a distinction is made between the church class and the dispensary class. I do not see that there is any real difference between the two. We need both. Dr. Bowditch asked what

I mean by recovery. It is, of course, difficult to determine definitely whether or not a patient has recovered entirely from tuberculosis. I keep my patients in the class until all symptoms disappear and their strength is restored. I do not allow them to return to work until I think they have made a full recovery. Of the 65 patients that I have sent back to join the ranks of the wage-earners, only six relapsed. The large percentage of the patients who remain permanently well after the treatment indicates, I think, that I did not send them back to work before the disease was definitely arrested, or before they had recovered their health. Doubtless patients have been kept in the class in some instances longer than was absolutely necessary. A reserve of strength is always of value, and the danger of allowing a patient with latent disease to return to work is very great. I should say that the average duration of the treatment in the class was from nine months to a year. I will look up that point, and will publish it in the report of the six years' work of the Emmanuel Church Tuberculosis Class. I stated that of our 117 cases, 64 recovered and 18 died. Dr. Brown asks what became of the other 35. Some of these left the class to enter sanatoriums or to live with friends in other parts of the country, and some were discharged for disobedience. Nearly all of these patients, however, made some improvement while taking the class treatment. Dr. Floyd says that 50 per cent. of the cases treated in the day camp of the Boston Consumptives' Hospital have recovered. If this be true it is most remarkable. This camp is located in Mattapan, and is about seven miles from the centre of the city. The patients treated there are obliged to travel this distance twice a day. If treatment which necessitates so much physical exertion yields 50 per cent. of recoveries among patients with active disease, both incipient and advanced, then my insistence upon the vital importance of rest in the active stage of the disease is absolutely unwarranted. If the statistics of this day camp are correct, as quoted by Dr. Floyd, they remove the ground from under my feet. I have watched the experiment of the Boston day camp with interest, but in the published reports of recent years I have looked in vain for any detailed statement of the results that have been obtained. A class, to be successful, must be under the direction of the right man. I believe, however, that the wrong man can be converted into the right man by training. I have investigated the cause of failure in a number of classes. Insufficient attention to the details of treatment was the true explanation in every instance. Many physicians thought that I laid too much stress upon what they regarded as unessential, and so they modified my rules. But patients treated in their classes did not do well, and the method was condemned and abandoned. No one can have success with the class treatment who does not fully realize the truth of Brehmer's dictum, that consumption, although a curable disease, is a difficult disease to cure.

A RETROSPECT.

A Few Thoughts and Suggestions based upon Twenty-five Years' Experience with Tuberculosis.

BY VINCENT Y. BOWDITCH, M.D.,
BOSTON.

It was before this Society that I first gave the results of a three years' experience with what was in 1894 still regarded as an experiment, when I published the results of treatment of pulmonary tuberculosis in a sanatorium situated near a large city, at a low altitude, not far from the sea, and in a climate considered, up to that time, most unsuitable to such a purpose.

The Sharon Sanatorium, at that time unique in these particulars, having before many years proved that it was no longer an experiment, is now entering the twentieth year of its existence. It is therefore with especial pleasure that I again address this Society, from which I have always received inspiration and friendly encouragement in my work since its beginning.

The faces and forms of many of those whom I remember with gratitude and affection have gone. In their places are others to whom I turn with confidence, believing that the same spirit prevails now as in earlier times, when good-fellowship and mutual helpfulness in our life work were marked characteristics in our little Society.

To-day I do not propose to give you statistical informa-

tion of exact results obtained at the Sharon Sanatorium in all these years. I have already done that three times before you in the course of my work, and I hope in the future to again summarize not only the immediate results of treatment, but its effect as far as duration of life afterwards is concerned. This time I shall deal largely in generalities, the result of thoughts and impressions received during my medical experience, believing that the strength of conviction which comes from close observation is often greater than that derived from the study of statistical tables arranged to prove certain definite facts.

I shall therefore speak to you not only upon the treatment of tuberculosis in the sanatorium with which I have been connected, but upon the broader question of the disease as I have been brought in contact with it during the last quarter of a century.

To those of us who can look back upon twenty-five or more years of medical experience, nothing is more striking than the change in attitude towards the subject of tuberculosis. The discovery of the bacillus by Koch put upon a firm basis what had been merely conjecture on the part of some observers—viz., the infectious nature of the disease. Later developments, moreover, proved its curability in a large number of cases by methods before entirely unknown or only partially understood. I refer to the therapeutic use of the tuberculins and to the so-called hygienic treatment of tubercular disease.

All these factors have helped towards the hope and belief that sooner or later the disease which has decimated populations for hundreds of years can in the future be so far kept under control as to finally rob it of its terrors. To those of a younger generation of practitioners it may seem strange that we of an earlier era should feel any special

encouragement in our outlook when consumption is still so rife in our midst. I can only "hark back" to my early years of practice and recall the desperate hopelessness in our minds as case after case of incipient disease would come before us, and the old routine treatment would be brought forward in the use of drugs *ad nauseum* or the threatened exile of the victim as the *sine quâ non* of cure, such advice being accompanied in those times with a sickening sense of inadequacy in a great majority of cases. Now with every case of incipient disease comes, even in the face of frequent disappointment, a bright sense of hopefulness based upon the experience of many years.

In ever-increasing numbers rise before us the faces of those who in former years were stricken with disease but who now, strong and well, are living examples to enable us to give hope and courage to others similarly afflicted who come before us. I say this with conviction in the face of a spirit of pessimism with which I come in contact occasionally both in the profession and the laity, but happily less frequently now than formerly. Even now I find it in the profession most markedly among those who see possibly a large number of patients with far-advanced disease, some of whom may have been discharged previously from sanatoria with the disease at a standstill, only to break down again when ordinary and unhygienic methods of life are resumed. Under such conditions a sceptical and even pessimistic attitude may be perhaps excused, although I believe it to be due to a one-sided view of the question by which one fails to weigh in the balance the fact that the many who do not relapse fail to appear again as patients, and are oftentimes forgotten, as proofs of the efficacy of what has been done for them.

This attitude of mind in many cases also is the result of what I have spoken of at other times and in other places,

viz., of a misapprehension of the claims of those who first advocated the worth of sanatorium treatment. The exaggerated statements at one time, moreover, of zealots who, in their first enthusiasm, claimed too much, brought for a time discredit and harm to the very cause they hoped to foster, because of the failure to verify favourable results unjustly claimed in many cases.

Those who most earnestly advocated modern therapeutic ideas in tuberculosis have never claimed that they had found the panacea for the cure of the disease. They have merely had the conviction, founded upon experience, that much more can be done than in former years to conquer it. In this belief they are sustained by the knowledge of the ever-increasing demand for sanatorium treatment, and that the death-rate from tuberculosis is diminishing—facts which are more convincing as a proof of the efficacy of these methods than pages of statistics such as have been in recent years published in England and also here, which attempt to show by figures that modern methods have after all not had much effect upon the decreasing death-rate from tuberculosis.

In reading these volumes of statistics, compiled by men of undoubted renown and skill, I am forcibly struck by the fact that their deductions seemed based upon comparison of data made by different observers, each of whom has his own special method of stating results. They seem, moreover, to disregard the important fact that there unfortunately exists the greatest disparity of opinion as to diagnosis of disease, conditions called "cure," and as to methods of treatment, whether of the so-called "climatic" or "home" variety. They thus pave the way for innumerable sources of error in compiling statistics for purposes of comparison.

As an example of what I mean, I refer to the Supplement of the Thirty-fifth Annual Report of the Local

Government Board of England, entitled "Report of the Medical Officer for 1905-6 on Sanatoria for Consumption and Certain Other Aspects of the Tuberculosis Question," by Dr. H. T. Bulstrode. Of the remarkable character of this publication I spoke at our meeting in Washington in 1908, and I therefore only refer now to the statement of Bulstrode that the statistics of decrease in the number of deaths from consumption in the last half-century fail to show any marked change since the almost universal adoption of sanatorium treatment. At the same time, in the introduction to Bulstrode's work, he is distinctly quoted as saying that as to the value of sanatorium treatment in pulmonary disease "he does not consider it possible or indeed desirable to draw definite conclusions on the evidence so far available"; and he expresses his entire approval of the establishment of sanatoria. He alludes, moreover, to the difficulty of making accurate conclusions from the imperfect condition of statistics thus far produced.

The absolute proof of how much present methods have a share in the conquest of tuberculosis must be left for coming years to show. We may argue the point without end in our attempts to prove the strength of our own position, and after all bring about no unanimous conclusion. In my own opinion, modern methods would have died a natural death ere this had they not shown themselves to be of great use; and one of the strongest proofs, after many years of experience, lies in the significant fact of the ever-growing desire in the civilized world to adopt these modern methods in order to accomplish the desired result. It would seem certain, however, that even the most sceptical would acknowledge that the sanatorium movement excited a personal and widespread interest in the subject, and gave a vast impetus to the later methods which seek to attack the disease from every point.

In touching upon pessimism as it affects the attitude of the laity, as well as of our own profession in appreciable numbers, I feel impelled to speak of that form, which I regret to say has not been infrequent in my experience, taken by those who say: "What is the use of making all this effort? Why not let the disease run its course and the inevitable end come without retarding it? Is it not an everlasting fight for the patient, full of discouragement and possible defeat? What is the use of dragging out and prolonging a wretched existence?"

With our present knowledge it would seem almost incredible that such sentiments could be held by anyone, and I must confess to a sense of shrinking as I recall and repeat such expressions, happily in my own experience not often heard and less frequently now than in former years. My whole soul rises in indignant and emphatic protest at the arrant cowardice implied in such an attitude of mind, to say nothing of the falsity of reasoning which has led anyone to such conclusions. Even if we were unable to prove that a large percentage of cases of incipient tubercular disease can be cured, yet the innumerable instances that we have had of heroic resistance to disease among those whose lives have been a constant source of inspiration and help to their fellow human beings, should be sufficient to silence those who would seem to believe that health is the one and only thing to be desired, and that all effort to save or lengthen life, if it involves invalidism, is to be discouraged.

The Necessity for Conservatism in accepting Conclusions about the Cure of Tuberculosis.

However desirous we may be of an open-minded attitude in consideration of the statements of others, experience, as we go on in life, teaches us caution in accepting hastily and

without sufficient proof the claims of many observers who report extraordinary results in the use of much-vaunted remedies for tuberculosis.

During my medical career I have had not a few instances of this nature, by which I have been led to believe that something of great use had been discovered which, after conscientious and continued trial on my part, has been placed in the list of many others tried and found wanting, only to be discarded as practically useless.

Many of you will doubtless recall the so-called "Curasso" or "peppermint treatment," by which every patient was made to inhale peppermint oil held at the nose night and day, while using at intervals the same remedy internally. At the Sharon Sanatorium and elsewhere this was resorted to for weeks and months, the only perceptible effect being possibly a lessening of irritative cough from its supposedly anæsthetic effect upon the throat. Otherwise it proved ineffective as far as appreciable effects upon the pulmonary lesions are concerned. And this in spite of the fact that detailed observations were recorded by a reputable Italian physician who claimed that a large number of cases showed a return to normal in previously diseased lungs—a statement which in itself should make us very sceptical as to the genuineness of the observer.

The so-called "Bergeron treatment," by which sulphuretted hydrogen was pumped *per rectum* into the intestines of poor consumptives, was widely and enthusiastically used for months; the inhalation of air through highly heated tubes was tried on many a poor, sweating and roasting patient because of high recommendation from European observers. Both of these fell into rapid, well-deserved disuse, only to be remembered as among the curiosities of therapeutics.

Over twenty years ago, an interesting instrument called the "Pneumatic Cabinet" or "Pneumatic Differentiator" was introduced by a member of our Society, ostensibly as a method for "making topical applications by means of inhalation of germicidal substances upon the diseased surfaces of lungs." Early in my own medical practice my attention was drawn to this instrument and for several months I devoted myself to its use to determine as far as possible how far its claims could be substantiated. I became convinced, however, before long of its failure, as far as its original purpose was concerned. The machine still exists and has, I believe, therapeutic possibilities in it as far as influence upon the circulation is concerned and especially in certain diseases of the heart, as shown us by Dr. Charles E. Quimby; yet as an instrument for making topical applications to the lung surfaces it has absolutely failed to justify its existence. For certain pulmonary calisthenic exercises, however, and for the inhalation of soothing vapours in bronchitis or throat troubles, we find it of use still at Sharon.

Creosote with its derivatives has for many years had its ardent advocates, and I am aware that a prominent member of our Society still believes in it as a curative agent—a fact which makes me pause as I state that in my own experience I have failed to get the success that he and others claim. Except that I have thought occasionally it diminished secretion, I have failed to be much impressed with it, and have found its disagreeable qualities to far outweigh its advantages.

A great quantity of "serums" were at one time placed on the market with strong testimonials as to their efficacy in the treatment of tuberculosis. The "Maragliano serum" was one of these; but an impressive silence on the question

during the past few years would lead one to think that it was one of the many other remedies long since put upon the shelf to be unused and finally forgotten because of their failure to justify the often extravagant claims of their sponsors.

I refrain from using further examples. These are sufficient to illustrate my meaning in speaking of the necessity of long and detailed observation before proper deductions can be drawn as to the efficacy of any one method of treatment.

This brings me to the subject of the tuberculin introduced by Koch as a curative agent many years ago.

Some of us well remember the almost insane behaviour of some of the profession and of the laity when Koch, in the 'eighties, was forced to give to the public his belief that in tuberculin we should find a substance of great aid in arresting the progress of tubercular disease. People from almost every part of the civilized world rushed to Berlin in order to get the first specimens of the precious fluid which was to rid us of this terrible disease. Emanating from such a source, although Koch himself did not wish to make his views public at the time, it was not unnatural that every human being, whether a victim himself to the malady or not, should wish to avail himself of the remedy at the earliest possible moment. We remember the inevitable reaction that came from such undue haste. We recall the warning of Virchow of the possible dangers of the remedy if used as it was then.

Disappointment and an equally unreasoning prejudice against the use of tuberculin resulted, and for many years it was held in disrepute except among a very few observers, who patiently kept at their work, believing still that Koch was correct in his idea, even if some modification of its first use should be necessary.

I must put myself among the ranks of sceptics, a position which I felt obliged to maintain for years, unwisely, as I now think, but in consequence of my early experience with tuberculin when I used it in a few cases of local tuberculosis but without appreciable effect. The warning of Virchow, moreover, at that time against the possibility of causing the acute miliary form of the disease, gave me an intense repugnance to its use, which I maintained for years until the observations of others, especially those of Trudeau, convinced me that I was possibly withholding a means of relief from some of my patients. I then gradually resumed its use in selected cases at the Sharon Sanatorium. In a former paper I have mentioned the details of the first cases in which Dr. Griffin and I began to use tuberculin therapeutically. I feel, however, that I may again touch upon them here, for they were both patients who had been given the benefit of thorough sanatorium treatment, hygienic and dietetic, for months, but without complete success. Subsequently, after months of careful and cautious use of tuberculin in the smaller doses of modern methods, they finally left the Sanatorium with the disease healed and have remained practically well in the seven years following their discharge and without relapse. It should be stated, moreover, that the first case had been previously discharged from the Sanatorium apparently cured by the ordinary hygienic methods; but, as had been expected, she relapsed upon her return to ordinary conditions of life a few months later. Since her discharge from her second visit, seven years ago, she has remained well; both of these cases being proofs apparently that there is something more than mere hygienic treatment to account for their present satisfactory condition.

The results of these cases gave us courage to adopt the same measures with others. My position now in regard to

the use of tuberculin is one of having been deeply impressed by its apparently beneficial effect as a therapeutic agent in many cases. In no sense can it be regarded as a panacea. I believe, moreover, that it should not be used indiscriminately, but that close observations by one skilled in its administration should be given a patient when under treatment. That proper hygienic care, including fresh air treatment pushed to its extreme limit, is the chief factor in the favourable results obtained in modern times I still believe.

In recalling subjects which have attracted attention in former years with reference to tuberculosis, it may be well to touch upon one which at first marked an epoch in the knowledge of the etiology of tubercular disease among human beings. I refer to the researches of my father, Henry Ingersoll Bowditch, and his English contemporary, Dr. Buchanan, both of whom had been working for years upon the same idea, each without the knowledge of the other's investigations until the publication of both papers about the same time; making one of those curious coincidences that we not infrequently come across in medical history. It was naturally gratifying to both men to find in the early 'sixties, when their results were published, that their views coincided upon the question of "Soil Moisture as a Cause of Consumption." Many of you may recall these works, which seemed to prove conclusively that families and communities were especially prone to consumption when living in low marshy regions, where dampness in the cellars and absence of sunlight in the houses were characteristics of dwellings.

Naturally in those days nothing was known of any specific bacillus as a direct cause of the disease; but an immense collection of data seemed to prove that the theories were based upon truth.

Even though we rely now upon the knowledge that the bacillus is the specific cause of tuberculosis, there seems to be no reason to doubt that for some reason, perhaps not clearly shown, residence on a damp soil produces some receptive condition of the human body which makes it especially susceptible to this sort of infection. It is well for us not to forget the teachings of those whose powers of observation were keen before the days of the discoveries of the microscope. The danger of residence on a damp soil and the advantage of a change from such unhealthy conditions were subjects which were deeply instilled into my mind during my earliest medical instruction. In the years which have elapsed, and with the lessened emphasis now laid upon this subject, I have seen not the least reason to doubt the truth of these teachings, and have kept them constantly in mind in dealing with consumptive patients.

Necessarily the treatment of such a broad subject in a paper of this sort must be of the most superficial nature; but as I believe it to be helpful to know the attitude of mind of those who have devoted the greater part of their time to one subject, I have ventured to make these suggestions today. My own attitude towards the question of the final eradication of tuberculosis may be perhaps summed up in the following way: I have had a faith for years, and still feel, that we may be on the eve of some brilliant discovery of a method which shall be a greater aid in our work than anything thus far adopted. That we are moving in the right direction and have already accomplished much I am firmly convinced. While I cannot share the optimism of those who believe that in a generation, by the general extension of present methods, we shall find tuberculosis under complete control, yet I believe that at the end of that time vast progress will have been made towards the desired result.

DISCUSSION.

Dr. E. O. Otis: It is a fact that should be mentioned here that the pioneer work of Dr. Bowditch, and of his father before him, led to the establishment of our State sanatorium at Rutland, the first of the kind in the United States, and now we have four such in Massachusetts. Dr. Bowditch, perhaps through the influence of Sharon Sanatorium, more than any other person, has been instrumental in establishing this great work in Massachusetts, an example soon followed by other States.

SOME OF THE RULES FOR THE TREATMENT OF CONSUMPTION, LAID DOWN BY SYDENHAM AND HIS SUCCESSORS.

BY RICHARD COLE NEWTON, M.D.,
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HAVING accidentally fallen in with a copy of "Domestic Medicine," or a "Treatise on the Prevention and Cure of Disease by Regimen and Simple Medicines," written by William Buchan, M.D., Fellow of the Royal College of Physicians, Edinburgh, of which the 8th Edition was published in 1784, I was astonished at the views which this writer expressed regarding the causes and treatment of consumption. This led me to consult the works of Sydenham (1680), Beddoes (1799), Barry (1726), Baron (1822), and Addison (1849), and my astonishment was increased not only by the wisdom and soundness of the teachings of these Englishmen of three or four generations ago, but by the almost incredible fact that such sound teachings have been practically ignored for over a century, and that now the profession is claiming to have discovered something new and of inestimable value in the treatment of tuberculosis, when in reality we know but little more in this respect than the writers I have quoted.

It is impossible to compress into a fifteen minute paper all that one would like to say upon this teeming subject, nor do I pretend that my search into the literature of consumption of a century or two ago has been in any sense ex-

haustive. I am painfully aware of the superficiality of my investigation, yet I have culled a few precepts to point a moral and adorn a tale, and I crave your attention while I preach a small sermon upon the texts furnished.

From time to time, through the history of medicine, an occasional giant has arisen whose sound common sense, accurate observation, and correct methods of reasoning have led to the discovery and enunciation of the solid truths upon which rational medical practice is founded. Like beacon lights in the darkness of the ignorance, superstition, and system-making which have surrounded, and often seemed to have practically shipwrecked medical progress, stand the names of Hippocrates, Sydenham, and others whose wise and sensible teachings, like the mariner's compass, pointed the true course toward the pole of truth. Why, in the management of consumption, the teachings of these fathers of medicine have been forgotten, it would be difficult to explain, did we not reflect upon the enormous power of fashion in medical practice and the general ignorance of medical history amongst the herd of medical practitioners.

It grates upon our vanity to have to acknowledge the truth of the saying that "the new things in medicine are the things which have been forgotten," yet in the treatment of tuberculosis we must fain acknowledge the truth of this statement, as the short study which we are about to make will prove.

Rays of the light of reason in the treatment of consumption break through the darkness which has pervaded the medical world from the earliest times, as, for instance, we now know that in the temples of Esculapius patients were placed in the fresh air for the cure of all diseases.

Celsus advised eighteen centuries ago: "Soon as a man finds himself spitting and hacking on rising in the morning,

he should immediately take possession of a cow and go up high into the mountains and live on the fruit of that cow."

However, to revert to the authors already mentioned, Sydenham says: "But of all the remedies for phthisis, long and continued journeys on horseback bear the bell, in respect to which it must be noted that, if the patient be past the prime of life, more exercise of the sort in question must be taken than if he were a youth or boy." "By the above mentioned method I have cured many, but if it hath failed at any time I have not known that long and persistent riding in good air (which refreshes both the lungs and the blood detained with hectical heat) hath ever failed, and though riding hath done well in hypochondriacal and other distempers, yet it does better in a phthisis than in any other case, for by such repeated succussions of the lower belly (in which are seated most of the separatory glandular organs) those are put upon the performing of their several functions by having their natural heat excited, and the blood is by this means depurated and (as it were) churned over anew." "In his journies (the patient) need observe no diet, but may eat and drink what best agrees with his appetite, only let him take care that the linen in which he lies be dry, for the dampness of it will quickly bring back all the mischief. . . ." "I am sure that if any physician had a remedy for the curing of phthisis of equal force with this of riding, he might easily get what wealth he pleased; in a word, I have put very many upon this exercise, in order to be cured of consumption, and I can truly say that I have missed the cure of very few. Insomuch that I think how fatal soever this disease be above all others, and how common soever (for almost two-thirds that die of chronical diseases die of a phthisis), yet it is this way more certainly cured than most diseases of less moment; provided always that this

travelling be long persisted in, according to the age of the patient and the length of the disease—for a man that is more ancient and hath had the disease a great while cannot expect to be cured so soon as he that is young and hath had it a little while—and provided also that, besides his persisting in riding, he go into new places, for the change of air and diet do as considerably add to the cure as the exercise itself, and I doubt not that those that travel into foreign parts to be cured of a phthisis might save their labour, and yet obtain their end, if they would ride a great way and through several places of their own country. Women or very weak men that cannot ride on horseback may ride in a coach and yet obtain the same end, as I have seen by often experience."

"Riding is as good on a decline or in phthisis as in hypochondriasis. It has cured patients whom many medicines would have benefited as much as so many words—and no more. This, too, not only in mere cases of cough and weakness, but after wasting night-sweats and colliquative diarrhœa having signified the approach of death—*Ultima linea rerum*. Indeed, deadly as phthisis is (killing two-thirds of those who die of chronic diseases), it has a specific in riding, as truly as ague has in bark, or the venereal diseases in mercury, provided only that the journeys are long enough and the beds at night are well aired."

He tells of a patient who had "fallen into hypochrondriasis" which had lasted for some years; finally the colliquative diarrhœa came on . . . "he consulted me, when I saw at once that there was no room for medicines. These had been tried too long, and too much in vain as well. I

Note.—The instance of Dr. Bowditch's forebears who were cured of consumption by a wagon journey through New England is too well known to need comment.

recommended riding on horseback—at first in short rides, such as his health would allow. Had he been a man of less acute judgment, he would never have been induced to try it. However, I asked him to persist in it until recovery. He took no care of regular meals, nor yet of the weather. He kept on for some months and rode over 1,000 miles, by which time he had gained perfect health and vigour."

Mr. Lawrence, Dr. Sydenham's nephew, "after a fever, fell into a cough and other signs of an incipient phthisis (the morbific matter having violently translated in upon his lungs), and at length the diarrhœa colliquativa came on; then the doctor sent him into the country on horseback (though he was so weak that he could hardly walk), and ordered him to ride six or seven miles the first day, which he did, and to daily increase his journey as he should be able until he had ridden 150 miles. When he had travelled half that way his diarrhœa stopped. . . . When he had stayed at his sister's house some four or five days his diarrhœa came on again; the doctor had ordered him not to stay above two days at most, for if they stay before they are recovered, this spoils all again, and therefore he betook himself to his riding again, and in four days came up to London perfectly cured."

Dr. Brady, writing to Dr. Sydenham, says: "No physician hitherto has attentively considered the force and influence of the atmosphere upon human bodies, nor yet has he sufficiently ascertained the part it plays in prolonging human life."

William Buchan, M.D., writing in 1784, says "that consumptions prevail more in England than in any other part of the world, owing, perhaps, to the great use of animal food and malt liquors, the general application to sedentary employments, and the great quantity of pit coal which is

there burnt, to which we may add the perpetual changes in the atmosphere or variableness of the weather."

Regimen: "On the first appearance of a consumption, if the patient lives in a large town, or any place where the air is confined, he ought immediately to quit it, and to make choice of a situation in the country where the air is pure and free." "Here he must not remain inactive, but take every day as much exercise as he can bear." "The best method of taking exercise is to ride on horseback, as this gives the body a great deal of motion, without much fatigue. Such as cannot bear this kind of exercise must make use of a carriage."

"It is a pity those who attend the sick seldom recommend riding in this disease till the patient is either unable to bear it or the malady has become incurable." "Patients are apt to trifle with everything that is in their own power. They cannot see how one of the common actions of life should prove a remedy in an obstinate disease, and therefore they reject it, while they greedily hunt after relief from medicine, merely because they do not understand it."

"Those who have the strength and courage to undertake a pretty long voyage may expect great advantage from it. This, to my knowledge, has frequently cured a consumption after the patient was, to all appearance, in the last stage of that disease, and where medicine had proven ineffectual. Hence it is reasonable to conclude that if a voyage were undertaken in due time it would seldom fail to perform a cure."

"Next to proper air and exercise we would recommend a due attention to diet. The patient should eat nothing that is either heating or hard of digestion . . . for this purpose he must keep chiefly to the use of vegetables and milk. Milk alone is of more value in this disease than the whole materia medica."

Note.—This dictum of Buchan's was strongly endorsed in the writer's experience in 1908, when to a *questionnaire* sent to a number of sanatoria in this country and abroad, regarding the proper treatment and regime to be observed for the cure of phthisis, answers were received from thirty-four of these institutions, and the opinion was strongly expressed that milk is the best article of diet in this disease, and that its action is largely curative.

Note.—A Scotch physician (name unknown) wrote in 1747 to his London colleagues upon the incontestible evidence of the results he had obtained that hygiene and diet are the most important means of cure in consumption, and that climate and medicine are but more or less precious adjuvants.—"Human Consumption and Civilization," p. 46.

Note.—In the summing-up of the information elicited by the *questionnaire* alluded to above, the following statement is laid down as axiomatic: "They (the methods now in vogue to cure tuberculosis) all point to the great truth that the means which are curative in this disease will surely prevent it, if employed early enough."

Buchan continues: "I have known very extraordinary effects from asses' milk in obstinate coughs which threatened a consumption of the lungs, and do verily believe, if used in this period, that it would seldom fail. . . . It ought to be drunk, if possible, in its natural warmth, and by a grown person in the quantity of half an English pint at a time, to be drunk three or four times a day."

"Some extraordinary cures in consumptive cases have been performed by women's milk. Could this be obtained in sufficient quantity, we would recommend it in preference to any other. It is better if the patient can suck it from the breast than to drink it afterwards."

"I knew a man who was reduced to such a degree of

weakness in consumption as not to be able to turn himself in bed." "His wife was at that time giving suck, and, the child happening to die, he sucked her breasts, not with a view to reaping any advantage from the milk, but to make her easy." "Finding himself greatly benefited by it, he continued to suck her, until he became perfectly well, and is at present a strong and healthy man." "Some prefer buttermilk, and it is indeed a very valuable medicine, if the stomach be able to bear it. Cow's milk is most readily obtained of any, and though not so easily digested as that of asses or mares, it may be rendered lighter by adding to it an equal quantity of barley water, or allowing it to stand for some hours and afterwards taking off the cream."

Buchan recommends that "flesh diet and strong liquors, which have been so long used by those who fall into consumption, must not be too suddenly given up, but gradually replaced with a diet consisting chiefly of milk and vegetables, which the sooner that it can be brought to bear, the better." "Rice and milk or barley and milk, boiled with a little sugar, is very proper food. Ripe fruits, roasted, baked, or boiled, are likewise proper. The jellies, conserves and preserves, &c., of ripe sub-acid fruits ought to be eaten plentifully." "Wholesome air, proper exercise, and a diet consisting chiefly of these and other vegetables, with milk, is the only course that can be depended upon in a beginning consumption." "If the patient has strength and sufficient resolution to persist in this course, he will seldom be disappointed of a cure."

"In a populous town in England where consumptions are very common I have frequently seen consumptive patients, who had been sent into the country with orders to ride and live upon milk and vegetables, return in a few months quite plump and free from any complaint." "This

indeed was not always the case, especially when the disease was hereditary or far advanced, but it was the only method in which success was to be expected; where it failed I never knew medicine to succeed. . . ." "All the food and drink ought, however, to be taken in small quantities, lest an overcharge of fresh chyle should oppress the lungs and accelerate the circulation of the blood."

"The patient's mind ought to be kept easy and cheerful as possible. Consumptions are often occasioned and always aggravated by a melancholy cast of mind, for which reason music, cheerful company, and everything that inspires mirth are highly beneficial." "The patient ought seldom to be left alone, as brooding over his calamities is sure to render him worse."

"Though the cure of this disease depends chiefly upon regimen and the patient's own endeavours, yet we shall mention a few things which may be of service in relieving some of the more violent symptoms. . . ." "It is common in this stage of the disease to load the patient's stomach with oily and balsamic medicines. These, instead of removing the cause of the disease, tend rather to increase it." . . . "Whatever is used for removing the cough, besides riding and other proper regimen, ought to be medicines of a sharp and cleansing nature. . ." "Acids seem to have a peculiarly good effect in this disease." "The vegetable acids, apples, oranges, lemons, &c., appear to be the most proper. Before we quit this subject we would earnestly recommend to all, as they wish to avoid consumptions, to take as much exercise without doors as they can, to avoid unwholesome air, and to study sobriety."

"Consumptions owe their present increase not a little to the fashion of sitting up late, eating hot suppers, and spending every evening over a bowl of hot punch or other

strong liquors. These liquors, when too freely used, not only hurt the digestion and spoil the appetite, but heat and influence the blood and set the whole constitution on fire."

Beddoes said in 1799: "The recoveries from phthisis, however few, that have taken place, whether from sea voyages or rare accidental combinations, show that the cure of consumption is no physical impossibility." "And that a remedy should not sooner have been discovered for this than for some other disorders is, perhaps, less owing to its essential nature than to those events which brought the European world acquainted at a certain era with Peruvian bark, quicksilver, and other powerful articles of the materia medica."

This observation, to my mind, probably touches upon one of the most pregnant facts in medical history. The great discoveries that quinine would cure malarial fever and mercury would cure syphilis seem to have led to the adoption of the prevalent doctrines that a specific remedy for every disease can be found by sufficient search. They seem to have led to the drug worship of the past century, and to have caused the average medical man to spend his energies in searching for the specific remedy for each complaint, to the exclusion of the study of pathology, not to mention hygiene and physiology.

Now that the wave of drug worship is receding, there is danger that we shall go too far in condemning these useful bridges that unquestionably help us over many otherwise impassable paths from disease to health.

That the treatment of tuberculosis is almost entirely hygienic, and that drugs have done more harm than good in its management, is now well enough understood. The number of human lives which have been sacrificed in the search for a specific cure for it can never be computed.

To return, however, to our author. After showing in a note that consumption was unknown amongst the fishermen and women who worked very hard out of doors, Beddoes lays down the following general rules as essential to exemption from the development of phthisis—viz.: "Much exercise in the open air, especially during the early years of life, such clothing as preserves temperate warmth, nutritious diet, into which animal food largely enters." He adds: "Thus may constitutions, moderately good, be prevented from alteration for the worse." "The puny may be rendered more robust upon the same plan, but the execution demands some management." "The following rules do not make up an entire system, but if their spirit be seized, an analogy will easily supply the omissions." "Let the anti-phthisical regimen begin early. Children cannot too soon after birth be removed into the country." "Animal food should form a considerable part of the diet where no positive indisposition exists." He says in a note: "A medical practitioner who has seen 70,000 patients belonging to the navy informs me (Beddoes) that he thinks Irish seamen more subject to scrophula than British. Let the reader compare this with what is said above on diet." After speaking of the undesirability of living like a butcher or a fish-wife for the sake of becoming strong and avoiding consumption, Beddoes adds, sententiously: "There seems to be no reason for alarm on this score; a habit (of body), little susceptible of pulmonary consumption, has no (necessary) connection with grossness or vice. These (habits) lead to excesses which induce different but equally fatal disorders."

Proceeding with his rules for preventing consumption, he says: "Dress should be such as to keep up a temperate feeling of warmth." He thinks flannels, the supposed sheet anchor of the anti-phthisical dress, "often injurious, and

not always indicated." "Immersion in the atmosphere of heated rooms for many hours together during the whole winter season is to be particularly avoided. . . ." "Warm clothing and a cold atmosphere seem to predispose much less to pulmonary complaints than cool dress and a hot atmosphere."

Beddoes continues: "The ingenious improvements in fireplaces by Count Rumford are, I fear, likely to be abused in this country, and, by rendering our apartments still hotter and closer, to add to the frequency of consumption." "There is no one habit in which it is more incumbent upon the superintendents of young people to make a change, nor is the undertaking difficult." "In lowering the temperature of our habitations, it is only necessary to guard the extremities, and particularly the feet, against the impression of cold." "The weakly *should never be* exposed to *considerable or continued chill.*" "In the application of this rule the difference of age will make a great difference. Infants, on whom the impression is less dangerous, should be inured to cold by immersion in water, but as the infant is more weakly, the water should be at a higher temperature." "At 65° to 70° so dense a medium will have sufficient conducting power for some constitutions at first." "A caution, perhaps, ought to be given against suffering the weakly, whether young or old, to sleep during a severe frost in apartments without a fire."

"*The consequences of a sedentary life are extremely to be apprehended for the puny members of phthisical families.*"

"Education should be regulated accordingly. . . . Imprisonment in grammar and boarding schools must be death to multitudes." "As the public is evidently coming more towards reason in the subject of education, would not semi-

naries, where the barbarous, monkish discipline (which our schools have retained so long after the abolition of monastic institutions) should be relinquished, and instruction through the senses, exercise, and *aeration* be the leading objects, now meet with sufficient encouragement?"

"In devoting their offspring to occupations into which they are to be initiated by any confinement in close and sometimes damp rooms, it is also to be wished that parents could be induced to place *health* in the balance against *wealth*."

". . . Where the young people have grown up under debilitating habits, it may be of use to make the masters and mistresses of families acquainted with the most probable marks of incipient consumption. . . ." "Speaking of the hesitancy of young people to consult the medical man for slight indispositions, Beddoes adds: "Much less, and would we wait until they declare themselves invalids." "In this, as in other things, there is a manner known to the French by the term *savoir faire,* by which the head of a family may maintain an acquaintance with the moral and physical situation of its members. This all parents will find their account in cultivating."

Beddoes also plainly saw the possible advantages of changes of climate. He says: "The prevalence of consumption in any climate does not demonstratively prove that it is not better than their own for invalids from colder latitudes." "Transportation from Herefordshire to Normandy, or to France, might cure cankered apple trees, though the climate of France should not preserve its indigenous apple trees from the canker." "In general, however, the difference between the sexes, the consideration of the exempted classes, and the lowered tone of health induce me to look to robustness of temperament as the grand preservative."

"That so many important questions relating to so universal and *so terrible* a malady should remain unsettled to the present hour, and that in order to provoke the truth a writer should be under the necessity of hazarding conjectures, seems to demonstrate how little men attend to what the most concerns them. For it is not from any natural necessity that opinion upon these points continues vague."

Note.—In speaking of the benefit alleged to arise to the consumptive from breathing the air of cow stables, this acute observer questions whether the benefit might not come from the temperature *alone*, and whether the animals might not be dispensed with. He gives a great preference to digitalis in treating consumption, but we must excuse some error in a work so sensible and so broad, and I might add, so ahead of the average medical opinion of his time or our own.

Barry, in his treatise on consumption, published in 1726, says: "Ulcers in the lungs, when narrowly viewed with microscopes, are covered with several insects," and from thence concludes that "they take their first origin from such animalcules which, being inspired with the air, fix their situation on the lungs and erode and ulcerate the vessels; and from the same irregular way of reasoning, these animalcules have been by others supposed to be the cause of several distempers, and particularly such as are contagious." This all reads like an inspired prophecy of the present science of bacteriology.

Barry continues: "The body in the disease must be kept as much as possible in a state of *rest;* even speaking is improper while the wound is fresh, as the lungs are particularly agitated by that muscular motion." "A milk diet, carefully directed, is preferable in this case to any other, as it is of a cooling, soft, nourishing nature, requires scarce any digestion, &c. . . ." "It is not only *balsamic* and re-

strains too quick a circulation, but seems specifically to correct that acrimony so peculiar to consumptive fluids."

"If cow's milk be apt to render them costive, it may conveniently be mixed with a small proportion of honey or exchanged for asses' milk, which is more light and opening, and less apt to curdle." "Breast milk is more natural, and in every respect preferable to any other, especially if the nurse be of a healthy constitution and feeds on a proper cooling diet." "If this method be timely and carefully continued and suited to the strength and constitution of the patient, many may be thereby recovered that will otherwise unavoidably perish." "For if bleeding to a sufficient quantity be deferred for a few days till the ulcer is formed, it afterwards proves of no service, but does rather hasten their death; and nothing more certainly contributes to this, and is more fatal in the consequence, than any error in the medicine or diet in the beginning." "When this regimen has been continued for the space of two months, or till all remains of the cough and other symptoms are carried off, gentle exercise, and particularly riding, in a fine, dry air, must be used, when the stomach is most empty, in the morning and afternoon. A greater latitude in diet is to be admitted by careful degrees."

Barry also speaks of an excessive meat diet as a cause of consumption (Kellogg's view).

Baron says (1822), in describing the treatment of a case, "and confined him to a strictly vegetable diet." This writer, however, relies much more upon drugs than diet or regimen, and evidently shows the tendency toward the intense worship of drugs which characterized the nineteenth century. This method of treatment no doubt led to the hopelessness with which the disease was viewed, as he says: "The treatment of the deplorable malady when it is fully estab-

lished affords nothing on which the mind of the physician can dwell with any satisfaction. The most powerful resources of his art fail, and he sees his patients pining in wretchedness, bereft even of the power of affording them temporary relief."

Addison said in 1849: "No one can meddle with a view to adjust any of the many links of life without attention to diet, air, and climate."

We have in the quotations just cited mentioned nearly everything that is considered essential in the modern treatment of consumption. These vital truths have been gathered from the writings of physicians living over one hundred years ago. Their truth is now proved. Verily we should not disdain the teachings of the wise and good men who have preceded us in medicine, and this leads me to ask: Is it not high time that a chair of medical history were founded in every medical school in America? Are we not often painfully and slowly going over the ground of treatment and regime in many diseases which we might have learned all about in a few hours by reading attentively the masters of physic like Sydenham? The new things in medicine are largely the things which have been forgotten. A proper course in medical history would not only be an act of justice to our predecessors; it would be an enormous saving of our own time, and might prevent many a mistake, and, incidentally, might, as in the case of the treatment of tuberculosis, have saved a few thousand, or perhaps a few million lives. The awful condition of the rich consumptive of the nineteenth century, with his windows battened down, his bed piled with blankets and quilts, the bed curtains tightly drawn for fear a draught might strike the patient, cod-liver oil, whisky, creosote, and many other nauseous and hurtful substances forced upon the poor sufferer; while

fresh air, the God-given remedy for the disease, was sedulously excluded. It is presumable that Sydenham and other authors I have quoted have been occasionally read by the drug-worshipping practitioners of the nineteenth century, yet their words must have sounded like idle tales, the vagaries of an ancient and forgotten regime. The medical mind reminds one of the absurd systems of modern ventilation which take no heed of the fact that air may be chemically pure and yet be dead. These expensive systems of supplying pure, yet nevertheless more or less worthless air depend for their inefficiency upon the windows being kept closed, so that God's air, the outer air, the moving, live air, is carefully excluded.

It would seem that the medical world has largely been taught the dry and valueless assumptions of the theory-makers in medicine, while the vital facts of the *experience* of such a man as Sydenham are as carefully kept from our students as vital air is kept from our school children.

THE ECONOMIC VALUE OF THE SANATORIUM TREATMENT OF PULMONARY TUBERCULOSIS.

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THE object of this paper is to endeavour to set forth the economic return to any given community from money invested in the treatment of its cases of pulmonary tuberculosis by modern sanatorium methods. Up to the present time all attempts to express the financial value of this work have been based entirely on estimates in which the value of a human life has been averaged usually at a very low figure, and this multiplied by the estimated number of lives saved through the agency of the institution in question. To this have been added other sums, also estimates, as to the amounts saved the families dependent on the patients in nursing, medicines, &c., and the amount saved the community for the care of those who would otherwise, sooner or later, have become a charge upon them. The figures thus compiled have indicated a splendid financial return upon the moneys invested in these institutions, but being based purely on arbitrary estimates they have failed in a great measure to give a proper impression of their true importance. I shall approach the question through another method, and where it is necessary to resort to estimates, base these on known factors which will fully justify them.

In the work at Gaylord Farm we have been peculiarly

fortunate in our opportunities for keeping in touch with our discharged cases. We are a small institution in a small State; our patients are largely from near-by localities; and my assistant, Mrs. Burgess, and myself have both been with the institution since its opening, and have personal acquaintance with all the old patients, and in most cases with their families and their physicians also. Quite a large per cent. of the patients return from time to time to visit us or else come to the office for examinations. With all these advantages we have been able to keep a record of discharged cases which would hardly be possible for most institutions, and on May 1, 1911, had a card index record of all but nine of the 676 cases discharged prior to November 1, 1910. Patients are recorded whenever seen or when reported by others, and in addition to this we send our annual letter asking for information concerning them. To ensure this reaching them we take three addresses for each patient, besides a record of the Lodges to which they belong, and the address, if any, of relatives abroad. The card index records the discharged condition, source of the report, age, present condition, weeks of life since discharge, weeks of work, occupation, wages, earnings for a year, and total earnings since discharge. Our patients come, for the large part, from the class of skilled mechanics, stenographers, and clerks whose wages are readily ascertained; and while in some of the cases the earnings have been estimated, this has been done by allowing the low wage of the scale known to be paid for whatever class of work was in question. The only patients with whom we have resorted to estimates pure and simple have been the housewives, and for these we have allowed an average of $8.00 a week. When one figures that these, besides earning their board and clothing, save the wages that would otherwise be paid a servant and do the

sewing and mending for the family, this estimate seems too low to admit of dispute. If this be allowed, we are dealing in practically all cases with a known wage scale. The weeks of work are also accurately recorded in the large majority of instances. A few have not filled out the circulars in as definite a manner as we desired. For these, when a case in good condition but not at work at last report states that he is working steadily, we have assumed that one-half the time between the two reports would be fair allowance for weeks of work, and have adopted the same method for those previously at work who report themselves as idle but do not give the data as to weeks. In all of these cases, in which we have subsequently been able to secure data, we have found the above plan of estimate a safe and conservative one. To further allow for any error we have made a straight deduction of 2 per cent., or approximately one week in every year, from the weeks of work and the earnings of all cases. This has given us a conservative, and we feel a very accurate, statement of the earning capacity of all patients since their discharge from the sanatorium, and it is through the study of these records that we can reach the true economic value of the sanatorium treatment of tuberculosis and demonstrate the return on the capital invested in it. This return will, of course, vary with the cases treated in different institutions. In our case we deal, as said before, largely with skilled workers, clerks, and stenographers. The industries of Connecticut employ a high class of labour, and the large majority of our male patients come from trades paying from $15.00 to $20.000 a week. We have had a few whose earning capacity was $25.00 to $30.00 a week, but who had, by reason of financial reverses, been placed where they were glad to avail themselves of the opportunity to secure treatment at the rate charged by us, $7.25 a week.

The inclusion of several of these in the cases discharged "improved" in Table II. is responsible for the increase in their average weekly earnings over those discharged as arrested.

TABLE I.—SHOWING EARNINGS UP TO APRIL 30, 1911, OF ALL DISCHARGED PATIENTS.

Classified according to condition on admission.

			Average age	Average weeks life	Average weeks work	Average earned	Average weekly
Incipient ... 140	Arrested 75	70 Well	26.7	126.2	90.5	$ 873.57	—
		1 Living	39.	260.	225.	6,750.	—
		4 Dead	...	191.2	71.	1,403.50	—
	Improved 53	56 Well	32.1	130.7	100.8	1,169.40	—
		4 Living	28.	161.7	29.4	611.44	—
		3 Dead	...	119.	49.	476.28	—
	Progressive 2	0 Well	..	...	..	...	—
		0 Living	...	...	...	...	—
		2 Dead	...	106.5	0	0	—
		All 140	29	131.	91.	1,020.60	$ 11.21
Mod. Advanced ... 373	Arrested 169	140 Well	31.9	125.	92.	1,170.32	—
		5 Living	38.	182.	140.	1,244.41	—
		24 Dead	...	134.	47.	666.21	—
	Improved 148	81 Well	34.	133.5	99.	1,168.79	—
		26 Living	34.	77.	26.5	256.27	—
		41 Dead	...	90.	8.5	102.50	—
	Progressive 56	8 Well	33.	184.	77.	742.11	—
		9 Living	30.	97.	18.	134.37	—
		39 Dead	...	48.	4.	25.83	—
		All 373	33	119.	70.	842.22	12.03
Far Advanced ... 120	Arrested 18	7 Well	27.5	159.8	108.	1,329.16	—
		1 Living	32.	236.	47.	970.20	—
		10 Dead	..	98.5	23.	241.08	—
	Improved 42	7 Well	29.	168.4	95.5	1,079.68	—
		8 Living	36.	120.	10.	96.78	—
		27 Dead	...	68.	3.	23.52	—
	Progressive 60	0 Well	...	...	..	...	—
		1 Living	32	53.	0.	0.	—
		59 Dead	...	35.6	.8	6.90	—
		All 120	31	70	16.	192.10	12.00
Grand Total All Classes		633	31	112.	64	$754	$11.78

Ratio of weeks of work to weeks of life ... .. { Incipient 70 per cent. / Moderately adv. 59 per cent. / Far advanced 23 per cent.

The Gaylord Farm Sanatorium was opened September 20, 1904, and on May 1, 1911, the time at which our yearly reports are made, we had 676 discharged patients who had been away from the sanatorium six months and over. Of these only nine were reported as lost, so that we can safely claim a high percentage of accuracy for our records. Thirty-four were school children and having no earning capacity as yet were omitted. This left the 633 cases on the records of which these studies are based.

In Table I. these cases have been classified with regard to condition on admission, and the discharge condition, present health, age, weeks of life, weeks of work, and earnings set forth at length. The table covers 140 incipient cases, 373 moderately advanced, and 120 far advanced. It is of especial interest in that it bears out the fact so often insisted upon that the results of treatment are in direct ratio with the stage of the disease at which the diagnosis is made. The incipient cases show an average total earnings of $1,020.60, the moderately advanced of $842.22, while the far advanced have earned on an average but $192.10. The same ratio holds good in the relation of the "weeks of work" to the "weeks of life" in the several cases. Here the incipients show a working capacity of 70 per cent. of their total time since discharge; the moderately advanced 59 per cent., and the far advanced only 23 per cent. The average weekly wages varies but little, being $11.21, $12.03, and $12.00 for the three classes in order as above.

In Table II. the cases have been classified according to the condition on discharge. Here the figures show the advantage of continuing treatment sufficiently long to secure an arrest of the disease, as many cases recorded "improved" on discharge would have undoubtedly been "arrested" could they have been induced to continue treatment long

enough. In this table we deal with 262 cases discharged "arrested," 253 "improved," and 118 "progressive." The "arrested" show an average total earnings of $1,039.48, the "improved" $719.53, the "progressive" only $72.55. The

TABLE II.—SHOWING EARNINGS UP TO APRIL 30, 1911, OF ALL DISCHARGED PATIENTS.

Classified according to condition of discharge.

Discharged		Average weeks life	Average weeks work	Average earned	Average weekly wage
Arrested 262	217 Well	105	92	$1,080.07	$11.74
	7 Living	201	139	1,993.55	14.33
	38 Dead	131	43	642.44	14.69
	Total 262	129	87	1,039.48	12.02
Improved 253	144 Well	83	59	1,164.73	19.74
	38 Living	95	24	211.84	8.82
	71 Dead	82	8	88.28	11.03
	Total 253	85	40	719.53	17.94
Progressive 118	8 Well	184	77	742.17	9.63
	10 Living	92	15	121.00	8.06
	100 Dead	42	2	14.12	7.06
	Total 118	56	8	72.55	9.07

Ratio of weeks of work to weeks of life ... ... { Arrested 67 per cent. / Improved 47 per cent. / Progressive 14 per cent.

percentage of "weeks of work" to "weeks of life" is 67 per cent. for the arrested, 47 per cent. for the "improved," and 14 per cent. for the "progressive."

Table III. shows the total earnings of all patients and the relation between this sum and the amount expended on the sanatorium. The figures as to the sanatorium include all expenditures of every kind since the foundation of the parent society, the New Haven County Anti-Tuberculosis Association.

The permanent investment of that Association in land, buildings, and equipment has been $132,292.86, interest on

TABLE III.—SHOWING EARNINGS UP TO APRIL 30, 1911, OF ALL DISCHARGED PATIENTS.

Condition on admission	Condition on discharge	Present condition	Total earnings	
Incipient	Arrested	Well	$61,150	
		Living	6,762	
		Dead	5,614	
				$73,526
	Improved	Well	65,487	
		Living	2,443	
		Dead	1,429	
				69,359
	Progressive	Well		
		Living		
		Dead		
Moderately advanced	Arrested	Well	163,923	
		Living	6,223	
		Dead	15,989	
				186,135
	Improved	Well	94,677	
		Living	6,476	
		Dead	4,023	
				105,176
	Progressive	Well	5,937	
		Living	1,210	
		Dead	1,008	
				8,155
Far advanced	Arrested	Well	9,305	
		Living	971	
		Dead	2,411	
				12,687
	Improved	Well	7,558	
		Living	775	
		Dead	635	
				8,968
	Progressive	Well	—	
		Living	—	
		Dead	400	
				400
	Grand total			$464,406

TOTAL EXPENDITURES, GAYLORD SANATORIUM, TO APRIL 30, 1911.

Capital invested in land, buildings, equipment, &c.	$132,292.86	
Interest on above at 5 per cent. as expended	30,918.86	
Maintenance	205,824.65	
		$236,743.51

which at 5 per cent. as expended amounts to $30,919.86 If we add to this the $205,824.65 spent in maintenance up to April 30, 1910, we have a total expenditure of $326,744.51, whereas the amount already earned by discharged patients, as shown in the table, is $464,406.00; a return of almost 200 per cent. within six years from the commencement of the work. These figures take into consideration none of the many indirect financial returns mentioned at the beginning of this paper. The sanatorium treatment of tuberculosis is the source of many direct and indirect savings to the community; savings which of themselves would make the work worth doing. The figures given above are, however, *facts*, and not estimates, and as a plain business proposition are sufficient, even in our commercial age, to demonstrate beyond a question the economic value of the work. Any enterprise which can prove an earning capacity of 200 per cent. in six years can confidently demand support; and our figures would tend to show that the unprecedented manner in which the movement to control tuberculosis has commanded the co-operation of individuals, municipalities, and governments throughout the world has not been inspired wholly by sentimental or humanitarian consideration, but is based upon the knowledge that the work pays, and pays well.

Satisfactory as the above figures may be they do not even approximate the real economic return from the work in question. Of the 633 cases reported above, 424 are living at the present time and have a future earning capacity with no further charge against them but the yearly interest on the invested capital. What is the value of these lives as expressed in earning capacity? This is a difficult question to answer because we have no very accurate tables for the expectation of life of discharged cases. On Table IV. I have made what I believe to be a conservative estimate of these

earnings. To permit of more accurate estimate I have discarded all "living" cases, *i.e.*, those recorded as progressive and improved, and dealt only with those now "well," *i.e.*, apparently cured and arrested. The 126 incipient cases have been discharged on an average of 128 weeks. It has seemed safe to me, in view of the very close classification of incipient cases, according to the standard of our National Association, to assume that these cases now well and at work two years and a half after discharge have an expectation of at least three-quarters of the normal average. The 229 moderately advanced cases are well and at work after an average of 154 weeks, or three years. The classification is here much wider than in the incipients, but I have felt that these cases well and at work after three years could safely be allowed one-half the normal expectation. The fourteen far-advanced cases are arrested and at work after an average of 163 weeks, and I have allowed for these one-fourth of the normal. Their number is so few that they could be left out without affecting the final total. Allowing, then, three-fourths the normal expectation for well incipients, one-half for moderately advanced, and one-fourth for the few far advanced, we have but to take the average yearly earnings for each class, as shown in Table I., and the total earnings expected from these cases by the time the last has died is given in the following table:—

TABLE IV.—EXPECTED EARNINGS OF PATIENTS DISCHARGED PRIOR TO NOVEMBER 1, 1910.

Type of case	No.	Average life since discharge	Average age	Normal expectation	Expectation allowed	Average yearly earnings	Total earnings expected during lifetime
Incipient	126	128 wks.	29 yrs.	34 yrs.	25.5 yrs.	$582.92	$1,872,921.96
Mod. adv.	229	154 ,,	32.5 ,,	32 ,,	16. ,,	625.56	2,292,051.84
Far adv.	14	163 ,,	28 ,,	35 ,,	8.75 ,,	624.00	76,440.00
				Total expected earnings			$4,241,413.80

In Table II. the total expenditures to date, including interest, were shown to be $369,037.87. Interest at 5 per cent. figured for the expectation of life for the three classes of cases amounts to $470,522.43, making a total of $839,360.30, on which we return to the community in earnings of patients a total of $4,705,820.00.

One criticism to which these figures may be subjected is that a certain proportion of these cases might have recovered their earning capacity without sanatorium treatment. It is impossible to estimate the number of these. There would, of course, be some, though personally I do not think the proportion would be large. Whatever their number, it would be more than offset by the fact that we omitted all consideration of the 160 cases treated between October 1, 1910, and April 30, 1911, or more than 25 per cent. on the total dealt with in our tables. Besides this, in order to be ultra-conservative, we have omitted all future earnings of cases classified as "living," *i.e.*, improved and progressive.

With proved earnings of 600 per cent. in an average period of 18.9 years, or a yearly income of 32 per cent. on our investment, we can permit those not satisfied with these figures to make whatever deductions they desire, and still claim that the public can secure no greater return on any of its invested capital than on that devoted to the betterment of the public health, if the return on sanatorium treatment of tuberculosis can be taken as an index.

My studies are based on the work of a small, comparatively new institution. Were the figures available, what would be the value of the twenty-seven years of work of the Adirondack Cottage Sanitarium? This total would, like the debt of gratitude we owe its founder, pass the bounds of comprehension.

DISCUSSION.

Dr. H. M. KING: This paper of Dr. Lyman's seems to me most timely and to have been the result of a very careful statistical study. What would have made the paper of more value, perhaps, would have been a comparison between the results, so far as the economic value is concerned, of sanatorium, home treatment, and dispensary or class treatment. There can be no doubt as to the absolute economic value of sanatorium treatment; but we do not know, and so far have no accurate data to determine, whether sanatorium treatment is of greater economic value than home, dispensary and class treatment combined. Now it is probable that, compared month by month and year by year, the sanatorium treatment is the more expensive method, but we do not know. Another point comes up, as to whether the sanatorium can accomplish the desired result, that is, a return of the patient to his earning capacity more rapidly than the other methods mentioned; we should know what percentage of advantage the sanatorium has in that particular regard. The length of time that the patient is incapacitated should be considered in an estimation of the cost of the method. For instance, if the sanatorium can accomplish the result in six months which the other methods accomplish in twelve months, then, of course, it has to that extent a greater economic value to be considered against the greater cost of the institution and its maintenance. This can be made by a study of the statistics of dispensaries and the other methods mentioned. The paper, as Dr. Lyman has presented it, strikes me as being most valuable in the present stage of our investigations on this subject. Here we see that the sanatorium yields a large interest on the investment, so to speak; we have seen that it yields over 32 per cent. a year. Now if we had some figures to compare the return on investment in the other methods we should know pretty well the relative merits of the sanatorium and the dispensary and class methods of treatment.

Dr. J. H. ELLIOTT: It would greatly add to the value of the paper if Dr. Lyman, before publishing, would indicate how many of his incipient cases were open tuberculosis and how many were closed. There is a considerable difference in the prognosis of these cases, and the excellent statistics presented by many of the German sanatoriums are acknowledged to be due to the fact that of their incipient cases a large percentage are closed cases.

Dr. H. R. M. LANDIS: I should like to ask if in estimating the cost for caring for these patients Dr. Lyman considered the cost of providing for the families of these patients, many of whom, I suppose, were married or had some depending on them. It is a very serious problem often to get rid of this incubus, and this has to be indirectly charged up against the earning power.

Dr. D. R. LYMAN: With regard to the question of the comparison of the value of the class and dispensary to the sanatorium treatment, statistics on this to be of value would not only tabulate the comparative cost, but compare the results as well. Dr. Elliott's suggestion can easily be followed out. As to the cost of care of the family, that does not enter into it at all. The cost of care in looking after these families is the same whether the man is sick or well. The factor which does count in comparison with other methods of treatment is the amount the patient can earn and contribute toward the family's support. In our cases this amount is "nothing."

WHAT IS A TUBERCULOSIS SANATORIUM?

BY EDWARD O. OTIS, M D.,
BOSTON.

THE above query may appear to be a strange and trifling one at this late day, when tuberculosis sanatoria exist all over the world and their status would seem to be indubitably settled. Nevertheless, I am inclined to believe that opinions still vary as to the exact scope and purpose of the sanatorium and the conditions requisite to constitute a genuine institution of the kind. It may be, moreover, that increased experience has gradually modified opinions previously held, so that what is called a sanatorium to-day is a different institution from what was formerly considered a sanatorium.

However this may be, my object in asking this question is to elicit the opinion of the members of this Association, and to find out what difference of opinion, if any, exists. I believe that such an expression of opinion by an authoritative body like this will be of distinct value. There are various other questions supplemental to the main one and included in it which I desire also to present. This question was suggested to me by the report of a Commission appointed by the State of Massachusetts to "investigate and report upon a system of caring for tubercular patients," and also by a change in the method of selecting patients for the Rutland Sanatorium recently made by the Trustees of the four Massachusetts State sanatoria or hospitals.

Previously the selection of patients admitted to Rutland was made by examination in Boston, which sent the largest number of patients, by the resident physicians of Rutland and by physicians in various other cities of the State, chosen on account of their supposed skill in determining the fitness of applicants for the sanatorium, the basis of admission being the incipiency of the disease and a reasonable prospect of cure or arrest. The change made by the Trustees was the abandonment of this method of examination and selection, and in place thereof any reputable physician in the State was permitted to recommend any patient he considered suitable for sanatorium treatment, such recommendation being reviewed by the Executive Secretary of the Trustees, a skilled diagnostician, although he, of course, neither saw nor examined the patient. If the physician recommending the patient considered the case a suitable one his judgment perforce had to be taken, for there was no means by personal examination of verifying, or otherwise, his statement until the patient arrived at Rutland.

This brings up one of the questions upon which I should like to obtain an opinion, namely, what is the best method of obtaining suitable cases for the sanatorium, and especially for a state sanatorium?

In the report of the Commission above referred to, it was recommended that all the women consumptives, both those now at Rutland and those in the three other State hospitals, should be segregated at Rutland, and the men likewise in the three other institutions which now receive both men and women in all stages of the disease.

This change would bring together in Rutland every grade of case—the incipient, the moderately advanced, and the advanced. The Rutland Sanatorium would then cease to be a sanatorium in the generally accepted conception of such an institution.

Among the various arguments adduced in favour of this change, the one which has to do directly with the question under consideration was the fact—as stated—that about thirty-three per cent. of incipient cases had been the usual average at Rutland, and "hence after many years of effort it had been impossible to establish a sanatorium for strictly early cases." This argument was further fortified by the results of correspondence by the Chairman of the Trustees with many of the leading experts in sanatorium management in Europe and America, and those consulted, almost without exception, the report goes on to say, "recognized the practical impossibility of keeping the incipient and advanced cases in separate sanatoria"; and, further, to quote from the report again, they also considered it "wholly practicable and unobjectionable to have patients in different stages of the disease in separate buildings in one sanatorium."

If we concede the validity of this argument, then there seems to be but one conclusion to be drawn, namely, that the commonly accepted idea of a sanatorium as an institution for the treatment of tuberculous individuals in the incipient stage of the disease, as is so frequently stated in reports and prospectuses of sanatoria, is erroneous, and hence the pertinent question, "What is a sanatorium?" and can an institution which receives cases in all stages of the disease be called a sanatorium? Furthermore, is it not possible and practicable to obtain either genuinely incipient cases, or, at least, cases which appear to be curable, provided the selection is made by experts? Can we determine with any degree of probability what cases are curable and what are not, so as to warrant us in making a rigid separation of the incipient, or those considered curable at the time of examination, from all the others? Or must we say, as Walther, of Nordrach, once said to me, that he never could

tell what cases would get well and what would not, and, therefore, he received into his sanatorium all classes of cases.

If this is the case, then all our sanatoria which pretend to receive only incipient cases—and a large number of them apparently do make this claim—are simply presenting an impossible condition and do not expect to live up to it? Granting that only genuinely incipient cases, as determined by an expert, can be obtained, can an institution which, in addition to such cases, also receives the moderately advanced or even the advanced, if they appear to offer possibilities of cure, be called a sanatorium?

Again, is it objectionable to receive in an institution called a sanatorium the early or curable and the advanced or incurable if they are segregated in separate buildings? If not, why then have two classes of public or State institutions—the sanatorium and the consumptive hospital? Surely one institution can be conducted more economically than two. Such, however, does not seem to be the generally conceded opinion; for, in the recent report of the Rhode Island Commission to consider the disposition of advanced cases of tuberculosis, for example, it was recommended that a State hospital be established for advanced cases, independent and separate from the State sanatorium; and such has been the attitude of other States and the resultant action therefrom.

Still another question might be asked in connection with my query, namely: Does the situation of the sanatorium, as regards climatic conditions, have anything to do in defining its status as a true sanatorium? In order to be such must it be situated in a region possessing certain favourable climatic elements as to altitude, abundance of sunshine, dryness, &c., as in mountainous regions or dry plains? Can we call an institution in or near a city, for example, a

sanatorium in the strict interpretation of the term, although it may receive only incipient or curable cases?

From the foregoing, my query may not appear, after all, to have yet been completely and satisfactorily answered, and I trust it may elicit the opinion of the gentlemen as to what constitutes a true tuberculosis sanatorium, and I herewith formulate my various questions in order that they may be more distinctly in mind:—

(*a*) In order to have a true tuberculosis sanatorium, must it receive only incipient cases?

(*b*) Can it be regarded as such if, in addition to incipient cases, it receives those moderately advanced or far advanced if they present possibilities of cure?

(*c*) Must it be situated in a region with especially favourable climatic elements?

(*d*) Can it be considered a sanatorium if advanced or hopeless cases are received?

(*e*) What is the best method of selecting suitable cases for the sanatorium, or can this be done under any method of selection?

(*f*) In a State or public institution is it practically possible to obtain all early or curable cases, and should such an attempt be abandoned?

(*g*) Is it objectionable to receive into the same institution called a sanatorium the hopeless cases as well as the early or curable ones?

(*h*) What distinction should be made, if any, between a sanatorium and a consumptive hospital?

DISCUSSION.

Dr. V. Y. Bowditch: I should like to speak a word about our sanatoria in Massachusetts now. I recently made a visit to the Rutland Sanatorium and, as far as the administrative conditions and

the character of the patients were concerned, I was much pleased at its improvement; but I was dismayed to see the large number of hopeless cases, some of them mere "wrecks," which were in the infirmary and elsewhere. I wish it to be understood that what I say is in no sense in a spirit of carping criticism of the Tuberculosis Commission, who have a very difficult task before them. I feel that the present plan of putting the admission of patients freely into the hands of the whole medical community is a great mistake. There should be a Board of Examiners in the State to act as a "filter," as it were, to determine what patients should be placed in a sanatorium and what ones should be sent to a hospital for far-advanced cases. It is, I regret to say, extraordinary to see what many men send as "incipient" cases in which all the symptoms are those of far-advanced disease. Two patients were recently sent by practitioners to Rutland as in the "incipient" stage, only to die within a few hours from far-advanced disease; and others are there who never should have been sent far from home.

As to keeping sanatoria for incipient cases alone, that would be absolutely impossible. From my own experience it is impossible to do this. Moreover, a great many cases that are not incipient, but which have got into the second stage, are far from hopeless. They often come in apparently very ill and improve in the most astonishing way. Such cases are, of course, suitable for treatment in our sanatoria.

I am more and more convinced also that the effect upon the favourable cases of far-advanced and dying patients is depressing and deleterious in a high degree. This point is now being discussed in the Massachusetts Commission, and I trust that with the establishment of hospitals for the advanced cases near our large cities and towns, it will bring Rutland and other institutions established for this disease back again more into line as sanatoria properly speaking.

Dr. LAWRASON BROWN (Saranac Lake): In determining the definition of sanatoria, we have to go back and consider the question historically. When these institutions were first started there was great doubt in everyone's mind whether tuberculosis could be cured, and the name then meant a place where one could get cured. I know to-day of but one institution which tries to limit the cases it receives almost entirely to incipient cases and they get but 50 per cent. Several years ago we had a method by which we selected from the waiting list the best cases and got 50 per cent. in the incipient stage. However, we all got into hot water and were much provoked. For this reason and because we felt it was a bad system, we gave it up. We can usually get only 25 per cent. of incipient cases and not any more. I do not believe many institutions get many more than this. However, we want cases that have some chances of recovery. Having lived for ten years in a sanatorium, I would say that there is a most

depressing effect on the patients of having two or three individuals die. It puts the others back, and for several weeks hinders progress. You must have detached hospitals for these cases which are apparently hopeless; later, if they show signs of improvement, they can be taken into a sanatorium and treated.

Dr. D. R. LYMAN: It is the experience of most of us that such deaths hold back our curable cases, and it does not make very much difference whether they are on the front porch or anywhere else; the question of the undertaker coming up there is the main thing, and the combination of the far-advanced and the hopeful and curable cases is bad. The Baltimore plan takes in any type of case, but they take them too far from their homes. There should be one place for curable cases, with especial facilities for the care of the doubtful ones, and another to take care of the hopeless.

Dr. H. M. KING: I would enter a word of protest against the idea that a death occurring in the sanatorium now and then is so awfully depressing. In my own institution perhaps I do not hear all the criticisms that are abroad, but I do not think I have ever heard it said that that special feature was so very disturbing. If an institution is divided into units and the reception hospital more or less remote from other sanatorium buildings, forming a sort of clearing house, and where it is well known that an effort is made not to admit hopeless cases, but where every patient is given a chance if there is any chance for him, a death occurring occasionally does not seem to be particu larly depressing. I have never seen any bad effects upon other patients from such an event, and I do not see that in an institution where such a thing is bound to occur once in a while that it should in any way act unfavourably upon other patients there.

Dr. C. L. MINOR: My views do not agree with those of Dr .King. To avoid what most patients find depressing I separate my patients into three classes—light, medium and advanced—placing them in separate houses. But man is fallible, and occasionally in my "light" houses I get in patients who rapidly prove that my prognosis was wrong. While my patients are, I think, generally remarkably cheerful and cheery, they are not so fortunate as Dr. King's patients, and a death in the house is most depressing and unfortunate in its effects on them. The place in which hopeless moribund patients are placed is in no sense a sanatorium, but a hospital, and it is absolutely necessary to have a hospital of that sort in every city as an adjunct to sanatoria, and it is one of the most important features of the fight against this disease. It should be separated absolutely from the sanatorium and should be run chiefly to protect the community and not so much to make the death of the patient easy, and there is absolutely no relation between such a hospital and the sanatorium.

Dr. H. L. TAYLOR: I believe the best arrangement for State and city sanatoria is that which we tried to inaugurate in

Minnesota, of putting up hospitals, which have to receive every citizen that applies suffering with tuberculosis irrespective of the stage of their disease, and from these hospitals the favourable cases are to be forwarded to the central State institution, while the unfavourable ones will remain until they die or go back to their homes. The homes are thus protected and the sanatorium is kept full of truly incipient cases. At present there is scarcely a bed in which a consumptive is welcome to die. Most of our institutions are for those who will get better. We should all have these small hospitals for advanced cases near the homes of the patients where their friends could visit them, and from these asylums send the favourable cases to the central State institution. I am sure the problem of dealing with the incurable cases could be easily solved in this way. I have heard many remarks from patients who say that it is most depressing to see that daily funeral going up "over the hill to the graveyard" in institutions where advanced and incipient cases are received, and where there must be numerous funerals.

Dr. J. H. ELLIOTT: The Province of Ontario has for some time been trying to solve this problem, and for some years has encouraged the building of local sanatoria for counties or groups of counties, yet it is felt that there are a number of smaller towns where the general hospital could very easily admit or make special provision for these tuberculous patients and avoid the expense of a special institution, and after sufficient observation send those curable ones to one more central institution. This would prevent much duplication of institutions. The Ontario Medical Association recommended and the Provincial Secretary's Department approved, that every general hospital make provision for the care of tuberculous cases where there was already no provision made in the way of a special hospital. Our public general hospitals receive a grant from the Province of $1.40 per week per patient and all our consumptive hospitals $3.00, so that those general hospitals putting up tuberculosis pavilions in their grounds would receive this amount for each patient received. It has been well said that a hospital is not a general hospital unless it cares for the tuberculous, but few can do so. This has a bad effect in the training of the nurses. If I telephone to the registry and ask for a nurse, they will ask, "What kind of case?" and then generally answer, "Oh, I do not nurse tuberculosis," and when you succeed in getting a nurse for your case she generally does not know anything about it. So that if these local hospitals care for the tuberculous in the advanced stages we solve that problem, and then the incipient cases can go to the more central institution. It is going to be very difficult to get competent men to take charge of a large number of small institutions, at least in Canada, and we know how results depend upon the director of the sanatorium. As far as

the mixture of the favourable and unfavourable cases is concerned, I must say that after ten years of sanatorium work it is depressing to have a death occur in your institution; the patients develop unfavourable symptoms as a result, and the excitement and the nervous depression that ensue last for days. If it can be avoided the classes should not be mixed.

Dr. JAY PERKINS: For some years I have been attending physician to the St. Joseph's Hospital in Providence. This hospital has no connection whatever with the general plan of stamping out tuberculosis. It takes in patients in all phases of the disease, and I want to bear testimony to the effect which the dying cases have on the other inmates. I have seen quite a number leave the institution when patient after patient died. I refused to serve as examiner for the State sanatorium because of their method of admitting cases. Practically all examined are admitted, and the result is that month after month no incipient cases whatever enter the sanatorium, and they have amongst their cases the advanced and far-advanced. Many patients go out there and are sent back within the week, and one patient came out at 8 o'clock at night and died in the morning Sanatoria are not for such a class of cases. Institutions for advanced cases should be separate from sanatoria for early cases.

Dr. R. C. PATERSON: While we all admit that our cases should not be mixed the fact of the matter is that in this part of the country (Canada) we have not accommodation at present for not only the far-advanced moribund, but those moderately advanced cases that are acutely ill. If there is any chance at all for a patient some of our institutions at least should take these patients in, not only for the benefit of themselves, but for the protection of the community and the other members of their families. We have to take them into our institutions even if it comes to mixing cases.

Dr. E. R. BALDWIN: In answer to Dr. Minor about the undertakers I would suggest that they attend to the "æsthetics" of undertaking. We try to avoid the appearance of the undertakers in the neighbourhood of the other patients. When a death occurs in our reception hospital he comes nearly always at night, if possible, while the patients are asleep. But with an institution with separate rooms a death is almost unnoticed, and we seldom have any conversation about the death of the patients.

Dr. J. W. BRANNAN: There seems to be no question that these cases should be separated. How are we to arrive at this? We have one method in New York and that is through a clearing house, An admission bureau has been established to which every case seeking hospital treatment is referred; it is then sent to the proper institution. It seems to me that this subject is so important that a committee should be formed to report at our next meeting the conclusions of the men connected with sanatoria in the various States;

that is, a consensus of the opinion of all doing this work, not simply an expression of individual opinion.

Dr. EGBERT LEFEVRE (New York): Much has been said of the organization of State sanatoria and the work done by them. Now we are having another development taking place, and that is the organization of county hospitals for the care of tuberculous cases. I think it should be urged upon those who are interested in these county hospitals that they be made the clearing places for the proper cases to be sent to the State institutions; while those with no ultimate hope of recovery could be kept near their families. I am glad that this matter was brought up here, because I think it is going to be a very important factor in the proper management of cases of tuberculosis, both incipient and advanced.

THE RELATION OF TUBERCULOSIS TO CHOREA, HYPERTHYROIDISM AND PHARYNGEAL HYPERPLASIA.

BY CHARLES H. MINER, M.D.,
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My interest in these relations has been aroused by the work at the State Tuberculosis Dispensary, in Wilkes-barre, Pennsylvania, where we have examined many children of tuberculous parents, and among them have found conditions present which seemed in some way related to the tuberculous infection they had contracted. First, we found a number with chorea or with a history of having had choreic symptoms. Second, among the older members of the families we found a number with the signs and symptoms of hyperthyroidism, and finally, we found a very large number with pharyngeal hyperplasia. The question naturally arose, what relation, if any, does the tuberculous infection bear to these conditions? In this short paper I will not be able to report any original investigations, but review briefly the literature bearing on these subjects and give the statistics from our dispensary.

We have gradually come to have a clearer view of the tuberculous process. In its beginning it is always, or practically always, a local disease. The actual primary infection depends on the entrance and deposition in the tissues of a few bacilli from without. Von Pirquet has divided the pro-

cess into three states analogous to syphilis: (1) Primary tuberculosis; primary effect on place of infection with participation of the regionary lymph glands; (2) secondary tuberculosis; a more or less general spreading of the tuberculosis some time later, but in direct connection with the primary infection; and (3) tertiary tuberculosis, a spreading of the tuberculous process, occurring years after the primary infection, with intense reactive processes, and especially cavity formation. When the first infection takes place during certain favourable periods of life (childhood, *not* infancy), the disease does not pass the primary localized lesions. An infection in infancy, especially in the first year of life, is nearly always followed by a fatal secondary stage.

Many children develop a non-fatal stage of long duration, with dissemination in the lymphatic system, and a tendency to catarrhal symptoms of the mucous membranes as found in scrofulosis. During all these stages the tuberculous process produces a toxæmia, and in proportion to the degree and intensity of the toxæmia the illness is serious. For this reason a small focus of disease may be of vastly greater importance than a much larger one. Before objective signs are demonstrable there may be evidence of the physiological effect of toxæmic disturbance in many functions of the body. The frequent coincidence of this toxæmia with other infections of childhood as measles, whooping cough, diphtheria and influenza is the cause in many cases of their fatal termination. I have frequently noted that diphtheria developing in children with tuberculous glands requires very large doses of antitoxin to produce curative effects.

Chorea.—R. W. Philip claims that this toxin is a neuromuscular poison and is an important etiological factor in producing another condition not commonly regarded as

related to tuberculosis, namely, chorea. He says: "Up to the present I have, with careful search, failed to meet a case of chorea which has not responded positively to the cutaneous tuberculin test, or has not yielded other proof of the presence of tuberculosis, and have departed from recognized therapeutic methods and have treated pronounced cases of chorea, some of the gravest character, by means of tuberculin with uniformly satisfactory results."

B. K. Rachford divides the causes of chorea into first, predisposing causes, including heredity, sex, age, and social condition. Secondary causes—as diseases which produce chronic anæmia or any other blood change that will interfere with the nourishment of the nerve elements. Among the diseases that act in this manner he places first tuberculosis, especially of the lymph glands; and claims that over 50 per cent. of the cases of chorea occurring in general practice have tuberculous anæmia. Rheumatism is a factor in about 20 per cent. of all cases of chorea. The incoordinated movements in chorea are a symptom of some underlying condition and not a distinct disease. The normal condition of childhood is constant muscular activity, and anything that weakens the child naturally weakens the nervous control, and so may cause unrestrained muscular action.

Among tuberculous children, especially girls, there are those who overwork in school and get into such a state of nervous fatigue, exhaustion, and irritability that the control centres lose their activity, their power, and their balance. The resultant state is one of uncontrolled muscular movements, and that has been called chorea.

Among 707 tuberculous children at the State Tuberculosis Dispensary, we found fourteen cases with chorea as a complication. Of these, seven also had enlarged tonsils

and four had a history of rheumatism. It is impossible to prove that the tuberculous toxin was the principal etiological factor in producing the choreic movements, but it undoubtedly was a factor in causing the original debilitated condition.

Hyperthyroidism.—Stanton, in 1905, called attention to the frequency of the symptoms of hyperthyroidism with enlargement of the thyroid in tuberculous cases, and in the thyroid glands of fatal cases of tuberculosis he found tubercles in a notable proportion of cases. Dumas cites a number of cases which he believes to be of tuberculous origin. Hufnagel, in 1,246 children, found six with apical tuberculosis and Basedow's disease.

In the Fourth Annual Report of the Phipps Institute enlargement of the thyroid gland is reported as occurring more frequently than any other complication. At the State Dispensary, out of 2,383 tuberculous cases, we found eighteen with enlarged thyroid and the symptoms of Basedow's disease. The tuberculous condition was diagnosed incipient in nine, moderately advanced in four, and far advanced in five.

Dr. D. J. McCarthy, who has given the subject some study, has kindly written me his opinion, which is as follows:—

"Embryologically the thyroid developing from one of the branchial clefts is essentially a part of the respiratory apparatus, and the nervous mechanism of the one is closely associated with the nervous mechanism of the other. It is more likely that the disturbance of the function of the thyroid is reflex from the disturbed respiratory action than that it is the result of the direct toxæmia acting on the gland. Stanton did some work to show the presence of tubercles in the gland

substance. There was, however, not sufficient evidence to establish a direct connection between the tuberculosis of the thyroid and the symptoms of hyperthyroidism."

Pharyngeal Hyperplasia.—To a greater or less degree lymphoid or adenoid tissue is present in every child's throat; it is found not only on the upper posterior wall of the pharynx (pharyngeal tonsil), between the faucial pillars (faucial tonsil), but also in scattered patches all about the pharynx and rhinopharynx. Enlargement of the tonsil depends not only upon the constitutional tendency of the individual toward an overgrowth of lymphatic tissue, but also upon the amount of irritation and infection they receive. All this region may be subject to tuberculosis, but the involvement of the faucial tonsil is by far the most frequent. Numerous investigators have written on this subject, and we may have first two generally recognized forms of tuberculosis.

(*a*) Primary tuberculosis of the tonsils, which has been proved to occur in 5 per cent. of all cases examined.

(*b*) Secondary tuberculosis of the tonsils, which is more common than primary, but less important. Wood's statistics show that considerably over half the cases of pulmonary tuberculosis develop secondary tuberculosis of the tonsils.

We may have, second, two other relations which may exist between tuberculosis and enlarged tonsils:—

(*a*) A number of recent investigators claim that the hypertrophied tonsils are really a latent form of tuberculosis and a manifestation of the tuberculous diathesis.

(*b*) The presence of adenoids and hypertrophied tonsils predispose to tuberculosis by the production of mouth breathing, and the general undermining of the patient's health. These relations to tuberculosis I wish to consider more fully.

Bartel claims that in animals we are able to demonstrate in lymph glands, in addition to the manifest tuberculosis with specific tuberculous changes, a stage of lymphoid tuberculosis in which the glands show mainly lymphocytic hyperplasia, or are apparently unchanged. The existence of such a lymphoid stage he also claims can be demonstrated in man. Tubercle bacilli have been found in tonsils and lymph nodes without apparent effect on them, except to produce a slight hyperplasia. Schmey, Philip, and others believe that the scrofulous diathesis and the tuberculous diathesis are identical, and that scrofulosis is a natural defence or an acquired adaptation of man in the combat against the tubercle bacillus. We may assume that in instances of prolonged latency of the disease itself, which are so frequent, the bacilli must slowly multiply at times, or assume a dormant stage unknown in artificial culture.

From recent studies we know that hypertrophied tonsils are very frequent among children of tuberculous parents. Floyd and Bowditch, in the study of 1,000 children of tuberculous parents, by systematic examination, showed that 50 per cent. had hypertrophied tonsils, whereas operable adenoid growths appeared only in about 145. Miller and Woodruff, among 150 children of tuberculous parents examined, found sixty-five with hypertrophied tonsils and adenoids. Cronin, out of 101 children of tuberculous parents, found hypertrophied tonsils in eighty-three, and adenoids in ninety-six. W. Taylor Cummins found, in the examination of 122 boys at an orphanage in Philadelphia, that of fifty-nine tuberculous boys, 55 per cent. had enlarged tonsils, and of sixty-three non-tuberculous boys 45 per cent. had enlarged tonsils. At the State Dispensary, out of 707 tuberculous children operable enlarged tonsils and adenoids were found in 25 per cent. of the cases.

Children of tuberculous parents often inherit a tendency to overgrowth of the lymphatic tissue in the naso-pharynx, and live in close contact with the disease. While primary tuberculosis of the tonsils is comparatively rare, we know that the tubercle bacillus frequently passes through these tissues without causing anything more than a chronic lymphoid hyperplasia, and it is evident that enlarged tonsils and adenoid growths are often associated with latent forms of tuberculosis.

Finally, the high percentage of hyperplasia of the pharyngeal tissues found among children of tuberculous parents induces a lessened resistance against the disease. Whether or not this hyperplasia is due to primary tuberculous infection, it is certain that these factors which operate against full growth and development, if combined with constant exposure to the bacillus, must result in some form of tuberculous infection. Therefore, in the treatment of these children, it is highly essential that they should have the benefit of early operation. The improvement after operation is shown by the following report of the first 100 cases operated on at the State Dispensary.

Report of the first 100 cases operated on for Adenoids and Enlarged Tonsils at State Dispensary No. 1

Number having tonsils and adenoids removed	40
,, ,, adenoids removed	50
,, ,, tonsils ,, ...	10

Diagnosis.

Pulmonary and glandular tuberculosis, incipient	86
Pulmonary tuberculosis, moderately advanced	10
,, ,, advanced	4
Number who gained in weight after operation	92
,, ,, lost ,, ,, ,, ...	2
,, showing no change	6
Total gain 92 patients	537 lb.
,, loss 2 patients	2½ lb.

Average length of time under treatment after operation $7\frac{1}{2}$ months.
Average gain ... ... $5\frac{2}{3}$ lb.
Number who had been running temperature between 99-10 previous to operation which returned to normal after operation 20
Number whose general condition seemed improved 91
,, ,, ,, ,, unimproved 7
Number discharged, disease arrested 10
Two died several months after operation:—
One from diphtheria;
One result of accident.

Special Cases.

One patient gained 18 lb. in 13 months after operation.
One 16 lb. in 14 months.
,, $33\frac{1}{2}$ lb. in 26 ,,
,, 18 lb. in 11 ,,
,, 9 lb. in 6 ,,
,, 8 lb. in 4 ,, (On list 2 months before operation and gained $1\frac{1}{4}$ lb.)
,, $9\frac{3}{4}$ lb. in 10 ,, (Gained only 4 lb. in the year and a half previous to operation.)
,, 7 lb. in 11 ,, (On list 4 months before operation; no gain.)
,, $12\frac{1}{2}$ lb. in 7 ,, (On list 1 month before; lost 2 lb.)
,, $5\frac{1}{4}$ lb. in 5 ,, (On list 10 months before operation and gained only 2 lb.)
,, $8\frac{3}{4}$ lb. in 1 ,, (On list one month before operation; gained 3 lb.)

Conclusion.

The invasion of the tubercle bacillus is often a slow process, and the significance of tuberculosis in childhood is not limited to the disease itself, but by lowering the tone and resistance of the child it leads to the development of abnormal conditions and other infections. We cannot prove that chorea, hyperthyroidism, and pharyngeal hyperplasia, found in tuberculous children and young adults, are caused by the tuberculous infection; but the knowledge of their frequent association may lead, through further investiga-

tion, to the discovery of some definite relation of tuberculosis to these conditions.

DISCUSSION.

Dr. J. Madison Taylor (Philadelphia, Pa.): With regard to hyperthyroidism in acute fevers, this matter was called to my attention practically by Sajous some time ago. There is a condition of hyperthyroidism which is immensely relieved by cold compresses to the thyroid. This condition is more or less common in acute infections, and the treatment locally by cold compresses relieves many distressing phenomena. I have seen some extraordinarily prompt recoveries from hyperpyrexias due to ice compresses on the thyroid.

Dr. H. R. M. Landis: With regard to Dr. Miner's statement that he has some 700 cases of tuberculous children under his care, I should like to ask on what grounds his diagnosis was made. I see every Saturday morning the children of parents under our care, and I find it a difficult thing to find out anything about these children so far as to say they are tuberculous. It is true many of them are anæmic, badly nourished, &c., but so far as finding anything in their lungs is concerned, I have not had much success. I doubt very much if I would have had the courage to have stated this earlier, had not Dr. Otis raised the question as to how many of these children really are tuberculous and the difficulty of making any definite diagnosis. Personally, I have found the von Pirquet reaction unreliable in children over two years of age. So far as the cervical lymph nodes are concerned, every palpable lymph node is enlarged, and that holds true not only for these suspected children, but also for all children between the ages of 2 and 15, even when brought up under the very best conditions and who are absolutely free from any taint of tuberculosis in the family. To state that palpable cervical lymph nodes are evidence that the child is tuberculous is an exaggeration.

Dr. Cleaveland Floyd: I agree with Dr. Landis that the determination of tuberculosis in children is one of the most difficult things we can meet with. In order to make a diagnosis frequently, the sum of all the signs and symptoms is necessary. Persistent elevation of temperature, von Pirquet test, localized enlarged glands, and clinical history are all important.

Dr. C. L. Minor: One thing helps us wonderfully in this direction, and that is the fluoroscope. It is practically true that all you see is a shadow, but the shadow of a large bronchial gland can be taken as pretty fair evidence of tuberculosis, though there are other

conditions, but not many, where bronchial gland calcification occurs. I think in children, however, the fluoroscope is a very valuable thing. We realize that although a great deal has been written on the physical diagnosis of enlarged bronchial glands, it is a difficult matter to diagnose them, and there is not one single method which is quite so valuable as fluoroscopy.

Dr. J. H. ELLIOTT: I would like to ask Dr. Minor if he has found that in using the fluoroscope one is not apt to mistake other shadows for bronchial glands. A number of cases of this nature have been reported, and yet no tuberculosis could be found at autopsy.

Dr. C. L. MINOR: The question of the accuracy of the fluoroscope in diagnosing the condition could, of course, only be settled by many autopsies. At the same time, the only thing that might imitate an enlarged bronchial gland would be a small aneurism of the aorta, and I do not know anything that will imitate the typical shadow, or anything that can be easily mistaken for anything but a bronchial gland.

Dr. C. H. MINER: These cases were obtained during three years' work at the State Dispensary, where we got hold of the children of tuberculous parents and other members of the families. As to the positive diagnosis, we could not be absolutely sure that they were all tuberculous, not having had careful fluoroscopic examinations or tuberculin tests, and in this short paper I have not gone into as many details as I would have liked, but the diagnosis was made only after a careful physical examination of each child by one of the physicians attending the dispensary.

INTERLOBAR EXUDATES.

BY ARTHUR K. STONE, M.D.,
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The presence of free fluid exudate in the thoracic cavities, in amounts of over half a litre, presents certain very definite physical signs which, for the most part, make easy its recognition. It is only when adhesions are present and encapsulation of the exudate occurs that the problem becomes complex. Everyone who has the opportunity to see many chest cases has encountered difficulties in the way of making an absolute diagnosis of pleurisy with effusion or of empyema. Many have been in the habit of using long exploring needles to find the hidden exudate, and almost all of us have a number of dry taps to our debit account, and that, too, in cases when the signs and symptoms have seemed to point clearly to the presence of fluid in the pleural cavity.

It is my intention to discuss only those collections of fluid which occur in the spaces which may be formed between the lobes of the lung. The formation of such spaces presupposes sufficient fibrinous inflammation to cause the edges of the lobes to adhere, while the formation of a fluid exudate takes place from the usually approximated surfaces, forcing them apart. Another form of interlobar exudate is found on the surface of the lungs, and is formed by forcing apart or infolding the lobes, so that small pockets are made along

the sulci, with the boundaries, the separated lobes of the lung and the parietal pleura, the edges of the lobes being adherent to the chest wall so as to surround the exudate.

Very little regarding the encapsulated exudates has been put in the text-books or monographs that will help one who really wishes to understand the problem and to act intelligently in the presence of perplexing signs. Musser [16, 17] has been the American author to call attention to the frequency of the presence of purulent exudates being located between the lobes of the lungs, and the recent advances made by the surgeons in operations upon the thoracic conditions have also emphasized the importance of understanding the position of the interlobar spaces as places where pus must be sought.

A. Fraenkel, in Germany, has written several papers upon interlobar exudates, and is the one man in Germany who has laid emphasis on the importance of the subject [3, 4, 5]. The pathologists have made singularly few observations regarding this condition. Of course, there is nothing new in the recognition of the interlobar spaces as the lurking places of exudates. The presence of fluid, both serous and purulent, was recognized by early observers, and Laennec [1] gives a good and satisfactory account of the pathological condition as he observed it in his large experience with *post-mortem* material, and his explanations of the pathological processes leading to the formation of the condition are perfectly sound to-day.

It is necessary for the diagnostician to hold in mind the general anatomical position of the sulci forming the boundary between the lobes of the lungs. On the left the lung has two lobes, and the line of cleavage starts at about the level of the third dorsal vertebra and descends obliquely until, in the posterior axillary region, it strikes the fifth inter-

costal space, whence it runs forward to the heart's apex, in either that interspace or beneath the sixth rib. On the right side there are normally three lobes, but the main sulcus, starting a little lower than on the left side, descends less abruptly than on the left, and, quickly gaining the fourth interspace, follows that around the chest until it reaches the sternum. Hence the course of this sulcus is much more horizontal than that on the right—a fact to be remembered when considering the shadow seen in the radiograph and on the fluoroscopic screen.

As this sulcus descends, and while still covered by the outer border of the scapula, it divides, the upper sulcus following the course already mentioned around the chest to reach the sternal border of the lung. At about the fourth interspace the lower division descends sharply forward, and reaches the base of the lung beneath the costal end of the seventh rib. This arrangement of interlobar spaces would seem to permit a greater accumulation of fluid to take place than would be possible on the left side with its single sulcus.

The general lines of the interlobar sulci are as I have given above, but one must not forget that many anomalies occur, and that the course of the sulci varies to a very considerable degree, as will be seen by consulting the plates of Rochard [10], and the description of others who have made a special study of these lung divisions. The third lobe on the right is not infrequently absent.

The presence of an exudate enclosed within the interlobar space will probably distort somewhat the position of the sulcus, usually in a downward direction, so that the division line between the lobes is apt to be lower than it should be found under normal conditions. Hence it is usually found that the resection of the sixth rib on the left in the axillary region will bring the operator directly upon

the exudate, or that the exploring needle might better be thrust into the sixth space rather than the fifth, and in the mid- or anterior-axillary line rather than farther back.

With the right side I have had much less experience, but the reports of cases from Fraenkel's clinic make it evident that the fifth space in the right axillary region is the most probable point of reaching an interlobar exudate with the least likelihood of injuring the lung.

The interlobar exudates may be divided into two groups—the large exudates, which may be either serous or purulent, and the small ones, which are practically always purulent. The question has been asked in a sarcastic manner as to how large an exudate can be held between the lobes of the lung, even if just extreme edges of the lobes are glued together with adhesions; and in reply I mean by large, an exudate of from 500 to 1,000 c.c. of fluid. Such an amount of fluid will give marked signs, which, if not masked by the presence of free fluid in the pleural cavity, will present certain quite characteristic physical signs which should enable one to make a diagnosis.

It so happens that the cases which I have recognized have almost all been located upon the left side. A. Fraenkel, on the other hand, has had the opposite experience. The most marked sign that I have found is that of a zone of dullness in the mid-thoracic region, extending from the axillary region to the spine of the scapula, and most marked in the posterior axillary region. Above and below there is fair resonance, even exaggerated (Skodaic) resonance. On the left side the semi-lunar space of Traube persists. Over the dull area slightly modified respiratory sounds may persist. There may be friction sounds over the whole chest which can cause much perplexity to the examiner. The chest sometimes distinctly bulges with the increased intra-

thoracic pressure. In the cases which I have observed situated on the left there has been practically no displacement of the heart to the right. A. Fraenkel, on the other hand, states that an extreme displacement of the heart to the left is a diagnostic sign of a right-sided interlobar exudate.

Röntgen-ray examination gives very valuable evidence. In typical cases there is a zone of shadow extending on the left from the apex of the heart upwards and outwards; on the right the zone begins a little higher, and is consequently more horizontal. Above and below this shadow the slightly modified clear space of nearly normal lung should show quite distinctly. In many instances the radiograph immediately above or below the main shadow is more or less fogged by the presence of some fibrinous exudate on the pleural surfaces. But the fact that in the lower portion of the plate the diaphragm is to be made out is suggestive, showing as it does that there is no free fluid in the lower portions of the thoracic cavity.

While the plates are very plain to one who is used to interpreting them, there is often so much shadow due to diffuse inflammatory processes within the thoracic cavity that good reproductions of such plates are made with difficulty. Seufferheld [8] is fortunate in having a good reproduction of his case. Fluoroscopic examination of the patient showing the shadow as its characteristic position and the diaphragm in motion is a great aid in clinching the diagnosis. Musser, on the other hand, seems to have had very little help from the Röntgen rays at the time of the writing of his paper in 1907. (Incidentally I want to put in a plea for the continued use of the fluoroscope in the diagnosis of certain thoracic conditions, the recognition of which cannot be made by the radiograph alone.) A series

of radiographs will enable the observer to follow the rise, diminution, and disappearance of an exudate, as has happened to Gerhardt [6] and myself [18].

Some writers lay special emphasis on the differentiation of inter-pulmonary inflammation from extra-pulmonary or pleural inflammation by the absence of sputum in the latter condition. Theoretically this should hold in most cases, but as a practical matter it will only be true in a limited number, for the inflammatory agent giving rise to extra-pulmonary irritation in most cases sets up bronchial irritation at the same time, so that some sputum is present.

On the other hand, destructive processes with resultant cavity formation can frequently take place, so that the patient, nurse, and closely watching physician is unaware from any increase of expectoration that the process is taking place until the finished product is manifest.

If, however, an abscess, *i.e.*, an inter-pulmonary or extra-pulmonary cavity in which pus has been confined, finally ruptures into a bronchus, the patient in almost every instance recognizes the presence of pus in the mouth. I have frequently had opportunity to observe the formation of pulmonary cavities, watching the patients from day to day, and noting the changing signs as the lung tissue seemed to dissolve, and I am sure that it is very rare for the cavity formation to take place in pulmonary tuberculosis with distinct abscess formation, such as one is apt to find after the pneumonic conditions, especially in those produced by organisms other than the pneumococcus.

There is no way, excepting with the needle, to tell whether an exudate that is under consideration is serous or purulent. In one of my cases where the symptoms were most severe, accompanied by chills and high fever, I was so convinced that pus would be found that it was a great

surprise to find a large serous effusion. The density of the shadow on the radiograph was no different from that of a practically similar case where the fluid was thick pus, and the constitutional symptoms not so severe as in the former case.

The earliest descriptions by Laennec were those where all the edges of the lungs were glued together, making a totally closed sac, in which the exudate was confined. Other varieties of interlobar exudates occur where a portion of the costal pleura is shut off by the adherent edges of the lobes of the lungs, and the lobes themselves are separated by the exudate, leaving a space shaped like a truncated cone, with the base resting on the ribs in the axillary region, and its blunt apex above and within between the lobes near the root of the lung. In this position the exploring needle enters the cavity at once, as can be easily made out by careful movements of the needle or trocar. The shape of the cavity is not necessarily as above described, but may be more elongated or even spherical, with only a very small surface of the sphere in apposition with the chest wall.

To recapitulate, the signs of an encapsulated interlobar exudate of considerable size are: A zone of dullness, more or less high pitched and tympanitic in character, with presence of broncho-vesicular breathing, over the dull area, often accompanied with friction sounds, if the condition is acute; below the dull zone the resonance and respiratory sounds are more nearly normal; on the left the tympanitic area of the stomach (Traube's space) is retained, and on full inspiration the more normal area below the zone of dullness increases in size; the dull triangle, the para-vertebral triangle, in the opposite thoracic cavity, is not present as is usual in large, free exudates. If the exudate is on the right side the heart is apt to be extremely displaced to the

left (A. Fraenkel); if on the left the displacement is not so marked as with free fluid (Stone); the radiograph will show a shadow extending from the apex of the heart towards the head of the humerus, or from the sternal junction of the fourth rib on the right outward to the head of the humerus; the fluoroscope will show the same shadow band and also the diaphragm in motion.

If the exudates are serous they can entirely disappear, as can other serous exudate in the chest or abdominal cavity. The small interlobar exudates which come to clinical notice are practically all purulent. Undoubtedly there are many small serous exudates, but they absorb and cease to give symptoms, and are never discovered. After severe pleuritis, usually accompanying a pneumonia, small encapsulated collections of fluid are left in depressions along the sulci between the lobes. These are frequently infected with the offending organism, and become purulent. Such collections of pus, seldom amounting to more than a tablespoonful or two, are to be found by careful percussion, and by the presence of tender spots. Remembering the lines of the interlobar spaces, one presses in each intercostal space with the tip of the finger along these lines until a tender spot is discovered. This and the percussion note and the exploring needle will usually serve to locate the small empyema immediately beneath the thoracic wall.

For these small collections of pus the Röntgen rays are usually of little assistance, for the inflammatory condition which has led to their formation has in almost all cases caused a diffuse shadow of sufficient density to obscure the shadow of this small localized collection of pus.

Similar inclusions of exudate take place between the lobes of the lung during the course of a pneumonia. They become infected, and consequently purulent. Very fre-

quently these small interlobar collections of pus become foul and gangrenous and empty themselves spontaneously through the bronchi, and they frequently are considered as lung abscesses, and for the most part very properly belong in that category. After pneumonic inflammation, especially in those caused by the pus-producing bacteria and influenza bacteria, and also from gummatous processes, destruction of the lung tissue can take place with the formation of pus. If the natural drainage way, the communicating bronchus, becomes blocked, an abscess is formed, and if putrefactive bacteria are present, the retained pus becomes foul. Some writers, as Robinson, believe that all small collections of pus, whether or not foul smelling, are either absolutely intrapulmonary in position or that the encapsulated pleural exudate in the interlobar space becomes infected through these pulmonary abscesses breaking through the pleural surface into the underlying exudate. The other explanation is that the exudate occurs first and becomes infected, as in any empyemata, and then in turn infects the pleura and the overlying lung tissue, causing localized gangrene of the lung and gradual extension to a sufficiently large bronchus to allow of the evacuation of the pus, which is usually foul. The process of extension and opening into a bronchus may be brought about if the surgeon's exploring finger is thrust into the cavity to aid the evacuation of the pus and detritus through the thoracic opening.

The question is largely an academic one and difficult of dogmatic solution, because patients with small abscesses usually do not die, and hence their lungs cannot be carefully dissected and the matter settled. In a long standing inflammation, coming to autopsy, the process is so extensive and the adhesions so many and complicated that it makes the condition in the early stages almost impossible of inter-

pretation. (The operating table also makes little chance for final settlement, for I have seen and felt through the opened thoracic wall, and arrived at an entirely different conclusion from the operator.)

To my mind the important fact relative to these small abscesses is that a number of observers have found them situated in the spaces between the lobes of the lungs and on the surface, their most common seat, as being in the vicinity of the interlobar sulci. Some of these very possibly start from intra-pulmonary necrotic nodules.

Remembering this common situation, if in doubt, the chest should be searched for tender points along the interlobar spaces. Percussion and auscultation along these lines should be done most carefully in hopes of finding traces of the small collections of pus. If it is decided to open the chest wall and explore, the region chosen should be along an interlobar space.

One of the practical conclusions that one comes to after experience and study of thoracic exudates is that, if a short exploring needle does not find fluid, the concealed exudate is usually in the interlobar spaces surrounded by lung tissue, and the needle will have to penetrate this lung tissue in order to reach the exudate. Therefore one should consider carefully the dangers of lung infection from the needle which may possibly be dipped in pus in the cavity which it enters. If it seems necessary to use the long needle, it is to be borne in mind that the axillary region, a little below the normal position of the interlobar sulcus, is to be chosen as the most probable place for immediately entering the cavity, and that here the intervening layer of lung tissue will have the least thickness. The same region is likewise the point of election for the removal of ribs and the exploration of the interlobar spaces.

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STUDIES OF THE LEUCOCYTES IN PULMONARY TUBERCULOSIS AND PNEUMONIA.

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It has long been recognized that the leucocytes of the circulating blood play an important rôle in many, if not all, bacterial infections, and numerous investigations have already contributed valuable additions to our knowledge of this subject.

The researches of Arneth, calling attention to the morphology of the nucleus of the neutrophile leucocytes, especially in tuberculosis, has stimulated further studies in this direction on the part of various observers. The results reported in this paper were first suggested by the work of Arneth, and represent effort to corroborate and amplify his results by various experimental and clinical observations, and especially to determine their value in the diagnosis and prognosis of pulmonary tuberculosis and pneumonia.

It seemed possible that Arneth had laid undue emphasis upon the significance of the neutrophile leucocytes, and that it was important to study the other forms of leucocytes in connection with them. Pneumonia was chosen as a companion study with pulmonary tuberculosis as forming a contrast of an acute with a chronic pulmonary disease.

An effort has been made to collect the information which is widely distributed in literature, and, by correlating our

own results with that of others, to try to present a fairly complete study of the behaviour of the white blood-cells in these two diseases.

The clinical material was obtained in the tuberculosis clinic, day camp and wards of Bellevue Hospital, and in the case of pneumonia in the medical wards of Bellevue Hospital, many of the cases observed being under the services of Dr. George R. Lockwood and Dr. William K. Draper, to both of whom we are deeply indebted for the privilege of studying these cases.

The Leucocytes in Normal Individuals.

As a basis of such a study it is essential to establish the normal conditions, both as to the total number of leucocytes in the blood and their distribution among the various classes as shown by the differential count.

Almost all authorities place the normal number from 5,000 to 10,000 per cubic millimetre. The text-books have evidently appropriated these results from the earlier observations of Hayem, Turk, Grawitz, Naegeli, and others. A recent careful study by Kjer-Petersen, however, places the average normal number between 4,000 and 5,000 in men, and comes to the conclusion that in women the normal count is very irregular, varying from 4,000 to 25,000 under various physiological conditions.

This observer lays great stress upon the fact that the blood is often not homogeneous, this being especially apt to be the case in women. He attributes the higher counts usually noted to improper methods, laying particular stress upon the necessity of taking the specimen of blood upon a fasting stomach before breakfast, and also upon the importance of invariable close approximation of the cover slip to the counting chamber so as to produce Newton's rings.

Arneth, Steffen, and others agree with Kjer-Petersen. In our own studies we found the average number of leucocytes in a large number of counts to be 9,000.

In the normal differential count there is considerable variation amongst the various authorities. This is largely due, however, to the fact that there is no unanimity of opinion as to what types of cells are included in the various groups. The following table gives the figures quoted by several independent observers:—

NORMAL DIFFERENTIAL.

	Poly.	Trans.	L.M.	L.L.	S.L.	E.	B.
Cabot ...	62 to 70	...		4 to 8	20 to 30	... $\frac{1}{2}$ to 4	... $\frac{1}{15}$ to $\frac{9}{10}$
Ewing ...	70 to 72		2 to 4	..	22 to 25	.. 2 to 4	... 5 to 2
Wood ...	65 to 75	... 2 to 4	1	...	22 to 25	. . 2 to 4	5
Naegeli	65 to 70	...	3 to 5	..	22 to 25	... 2 to 4	5
Webb and Williams	54			...	24 to 19	. . 2	.4
Da Costa	60 to 75	...	4 to 8	...	20 to 30	... .5 to 5	5

Many emphasize the importance of calculating the actual number of each class of cells rather than indicating the results by percentages. In our own work we have discarded the terms "transitional" and "large mononuclear," and in our differential count these cells as described by others are probably partly included in the polynuclears and in large lymphocytes.

THE BIOLOGY OF THE LEUCOCYTES.

In order to properly understand the significance of the differential count of the leucocytes, particularly of the work of Arneth, it is valuable to summarize briefly the theories concerning the development of the leucocyte.

There are two general theories regarding this development, dividing hematologists into two distinct schools.

One, under the leadership of Ehrlich, considers that the polynuclear neutrophiles, eosinophiles and basophiles are derived only from their corresponding marrow cells, and that there is never a transition from the lymphocytes to the polynuclear forms. The lymphocyte, according to this school, develop from the various lymphoid organs; some even from lymphoid tissue in the marrow and pass through the various stages of lymphoblasts, large lymphocytes and small lymphocytes, but never into the types of cells with granular cell bodies.

The large mononuclears and transitional cells, according to this school, are separate entities derived from the marrow, and probably the transitional cells are derived from large mononuclears, and in turn are transformed into neutrophiles. Pappenheim, Naegeli, Weidenreich, and the majority of observers now accept this theory.

The other theory held by the Russian school, under the leadership of Uskow, and which is also supported by Grawitz, hold that the neutrophile cells are frequently derived from the lymphocytes, and that the so-called transitionals often represent a stage between these two types of cells.

Practically all authorities agree that true lymphocytes do not act as phagocytes, although it has been demonstrated that they do in some way unfavourably influence the development of bacterial infection in the body.

In the development of neutrophiles, Arneth's contention is that their progress from the myelocyte is marked by changes in the nucleus, it being first indented and bent and finally lobulated, the mononuclear forms therefore representing the younger and the multinuclear forms the older type of cells. The granules also are more numerous in the older cells. In the younger cells the granules are apt to be first basophilic and later oxyphilic. The origin and significance

of the eosinophiles have been carefully studied by Brown, but accurate scientific knowledge of them is still lacking.

Arneth's Blood Picture.

In developing his theory of the changes in the nucleus during the growth of the neutrophile, Arneth has divided the neutrophiles into various classes, according to the number and shape of the nuclear segments. This he tabulates into a very involved blood picture. His contention, supported by numerous clinical observations, is that in various diseases the differential count of the neutrophiles, according to his scheme, shows very often an abnormal predominance of the younger forms of cells, which he calls a shifting to the left in his blood picture, that this shifting is very characteristic and represents a definite reaction on the part of the organism to the infection, and that a study of these changes forms a valuable basis for the differentiation of diseases and knowledge of their clinical course and subsequent history.

Arneth's work has attracted a good deal of attention, and many reports based upon his theory are now contained in literature. Hiller, in addition to finding Arneth's method unreliable clinically, because of the great variations in the normal, and the fact that the changes noted bore no relation to the similarity of the disease, disagrees with the theory of Arneth, contending that the neutrophiles are derived from lymphocytes. Pappenheim successfully refutes his contentions. Pollitzer dissents very strongly from Arneth both as to his theory of the development of the nucleus, and also holds that the changes in the nucleus noted are due to artifacts caused by the method of staining.

Arneth's reply and our own investigations discredit

Pollitzer's contentions. Busse objects on the ground that experiments showed that there was no variation of phagocytic power among the different classes of neutrophiles according to the number of nuclear segments. He consequently argues against Arneth's conclusions that these variations in the nucleus denote variations in efficiency against infection. Arneth, in his reply, denies the importance of these observations.

Zangemeister and Ganz object to Arneth's method of considering the neutrophiles to the exclusion of the other forms of leucocytes, and also to Arneth's classification. Their experiments with streptococci tend to show that the mononuclear neutrophiles are the most important from the standpoint of prognosis, the polynuclear neutrophiles and the eosinophiles coming next in order.

Flesch and Schossberger studied many diseases in children, and, while agreeing to the fact that the shifting to the left did occur under various conditions, found that this shift had no relation to the clinical course of the disease. Paulicek also found that in tuberculosis the blood picture was of no value clinically either in diagnosis or prognosis. Bourmoff and Brugsch came to similar conclusions. In this country Kagan and Solis-Cohn and Strickler found Arneth's methods of no clinical value.

Many other observers, however, particularly recently, have corroborated Arneth. Among these are Bochenski, Kownatzki, and Grafenberg in sepsis, particularly in puerperal fever; Kohl and Kothe in appendicitis, and Sonnenberg and Kothe in peritonitis. Esser in intestinal diseases of children, and Lewinson in several diseases, found Arneth's method of value both in diagnosis and prognosis. Many others have corroborated Arneth's methods in tuberculosis. These will be noted more in detail later.

Blood Picture Indices.

Many observers, including ourselves, have found Arneth's method very cumbersome on account of the multiplicity of detail, and that consequently it lacks definiteness, which impairs its clinical value. Various suggestions have been made by which the variations in the nucleus of the neutrophiles might be noted by a definite index. For this purpose some use simply the number of neutrophiles, which are mononuclear as an index, claiming this as a sufficient measure of the shifting to the left. These are Zangemeister and Ganz, Kothe, Sonnenberg, and Kothe and Kohl. Others, including Klebs, Dluski and Rospedzihowski, and Minor and Ringer, use the sum of classes one and two of Arneth's picture as an index.

Adolph Wolf advocates a total nuclear count of the neutrophiles, counting the round segments as one and the bent or loop forms as one and one-half, and in counting notes only the number of these two types of nuclei and totals them for his nuclear counts. Von Bonsdorff has a similar method somewhat modified. Sabrazes has worked out a neutro-leucocytic and neutro-nucleoleucocytic quotient as an index. Bushnell and Treuholtz use the same classes one and two and one-half of class three as an index. In our observations we have followed this suggestion, as it seems to lose less of the value of Arneth's original classification than do the others.

Technique.

In our observations the specimens of blood are usually, but not invariably, obtained in the afternoon from three to four hours after the ingestion of food. The other more usual causes of physiological leucocytosis, such as exercise and cold baths, were avoided; also no cases were studied after hæmorrhage.

We emphasize, as have others, the importance of obtaining thin and even smears of the blood for differential count, and of closer proximation of the cover-slips to the counting chamber for enumeration.

After numerous experiments in various methods of fixing and staining, we found that fixing by drying in the air and passing the slide two or three times across the flame, and that Wright's stain, made up fresh, produced the best results for the study of the nuclei. Enough stain is dropped on the slides to cover the smear, and the dish then covered for one minute. It is most important to have fresh stain often, as Wright's stain does not keep well.

The slide is left for two or three minutes with the stain, at the end of which time eight to ten drops of tap water are dropped on and the dish again covered for one minute, or until the metallic scum appears, when the slide is washed by dipping in a glass of distilled water and out quickly; then it is blotted and dried. All counts should be made with the oil immersion lens.

One hundred neutrophile cells were counted in each observation, and the other forms of cells found during this count were noted, so that an average of 140 to 150 leucocytes were counted in each observation.

Many slides were studied by two or three separate observers, and the similarity of results in the Arneth counting satisfied us that it is an accurate clinical procedure.

In differentiating segments of nuclei, superimposed segments were always counted separately, as were those connected by thread. Those, however, having a connecting isthmus were counted as one segment.

Pulmonary Tuberculosis.

Our observations in pulmonary tuberculosis were made upon 78 cases, with a total of 315 separate blood counts.

The period of time covered by our studies was three years, and this has made it possible to follow many cases of tuberculosis over a long period, which is very important in any effort to draw conclusions from observations made in regard to this disease.

We wish to emphasize strongly the importance of studying the changes of the blood according to the clinical course of the disease, and not according to the pathological conditions in the lungs, as has been done by the majority of observers who have reported upon the changes in the leucocytes in tuberculosis, many of whom have followed the classification of Grawitz.

We have classified our cases according to the stages of the National Association, and in addition to that according to the clinical prognosis at the time of the first observation, and have followed these cases into their subsequent history, endeavouring to co-ordinate our blood findings with the clinical course.

The Number of Leucocytes.

The majority of authorities state that the leucocytes are not changed in uncomplicated tuberculosis, but are increased when the secondary infection occurs, resulting in caseating lesions or cavity formation or with exudative inflammation, or in some of the complications such as hæmorrhage and enteritis.

Kjer-Petersen made a particularly careful study of the number of leucocytes in tuberculosis. He comes to the conclusion that the extent of the lesion has no relation to the number of leucocytes; that in men in early stages the number is normal if there is no fever, and in third stage cases with no fever moderately increased but very variable—6,000 to 15,000.

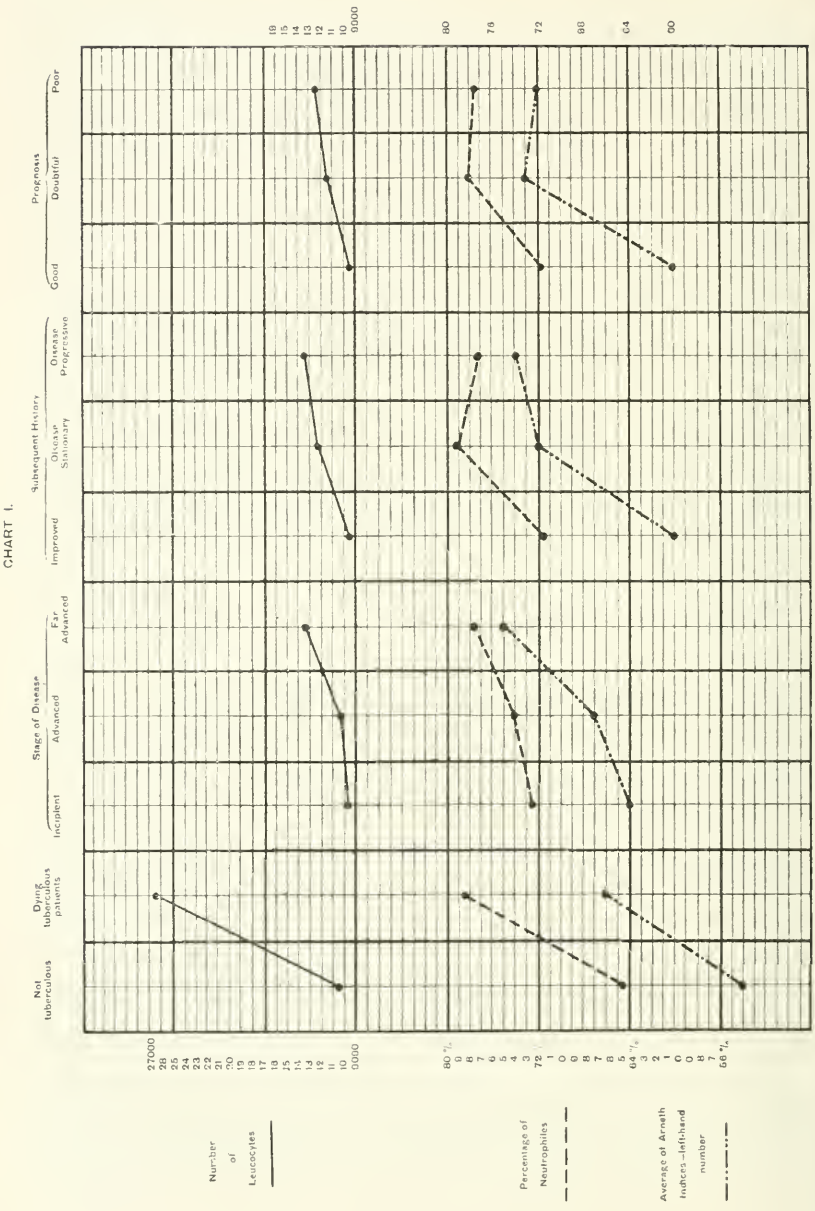
In febrile cases there is some increase in all stages, and particularly those of continuous fever, which he attributes to mixed infection. Other cases of pure tuberculosis with continuous fever are very variable, but average low counts. In women, as already stated, he found the counts very variable.

Stein and Erbmann, Kjer-Petersen, Applebaum and Steffen think a sudden increase in leucocytes important evidence of cavity formation. Richard, Bezancon, de Jong and de Serbonnes, Halbron and Steffen emphasize the importance of following the clinical course regardless of the pathology, and found a tendency to leucocytosis with the exacerbations of the disease.

Claude and Zaky, in guinea-pigs, obtained similar results, the leucocytes in the controls being increased, and in treated animals less so. Ullom and Craig state that a decrease in the number of leucocytes in advanced cases is unfavourable. Arneth also looks upon a leucocytosis as favourable and states that a shifting to the left of his blood picture is worse if the number of leucocytes is low. Craig disagrees with Stein and Erbmann in the significance of the increase of leucocytes with cavity formation. They found often no leucocytosis in cases of cavity.

Our own results in the enumeration of the total number of leucocytes coincide closely with those obtained by other observers, excepting that the average obtained in incipient cases and in the non-tuberculous cases is a little higher, 9,874 and 10,209 respectively. There is a distinct increase in the number of leucocytes with the progression of the disease. This is graphically shown in Chart 1. The striking difference between the non-tuberculous (10,209) and the moribund cases (26,300) corresponds with the reports of other observers of the frequent marked leucocytosis in dying cases.

CHART I.


Not tuberculous
Dying tuberculous patients
Stage of Disease
Incipient
Advanced
Far Advanced
Subsequent History
Improved
Disease Stationary
Disease Progressive
Prognosis
Good
Doubtful
Poor
Number of Leucocytes
Percentage of Neutrophiles
Average of Arneth Indices—left-hand number

The variations according to the stage, the clinical prognosis at the time of observation, and the subsequent course of the disease, show a distinct relationship between these factors and the number of leucocytes, which the chart shows better than description. The fact that the figures shown for the prognosis correspond quite closely with those for the subsequent history, would appear to make the enumeration of the leucocytes in tuberculosis a procedure of more prognostic value than it is usually considered.

Inasmuch as our cases have been followed in the majority of instances for more than two years since the blood counts were made, the data presented as to the subsequent history represent accurately the course of the disease.

Polynuclear Leucocytes.

Almost all observers have found that when cases of tuberculosis showed a leucocytosis, it was usually of a polynuclear form, and it is explained by the incidence of secondary infection. Experimentally, Achard and Loeper found that there was a primary increase in the polynuclears followed by an increase in the mononuclears.

Claude and Zaky also found that the percentage of polynuclears was much less in treated animals with a tendency to localized lesions than in the control animals. Bezancon, de Jong and de Serbonnes consider a polynucleosis as significant of acute and active disease and of great value in both prognosis and treatment, stating that all active treatment, such as tuberculin, arsenic, superalimentation, &c., is contraindicated if polynucleosis is present. They consider it a guide to the dosage of tuberculin similar to the opsonic index.

Almost all observers consider an increased percentage of polynuclears an unfavourable sign.

In our own studies the percentage of neutrophiles varies from 64.4 per cent. in the non-tuberculous, to 78.5 per cent. in the moribund cases, and in general the percentage is higher the more advanced the disease and the more unfavourable the prognosis and subsequent course. All of these percentages are high in our observations, even the incipient cases showing a percentage of 72.4 per cent.

The increase in the more unfavourable cases, however, is very marked and would seem to corroborate the observations of others that the leucocytosis of tuberculosis is due to an increase in the polymorphonuclears. A high percentage of neutrophiles would therefore seem from our observations to indicate an unfavourable prognosis, and this would be the more probable were an actual leucocytosis also present.

Arneth's Blood Picture.

As already stated, unfavourable clinical reports upon the value of Arneth's blood picture in tuberculosis have been made by Paulicek, Bourmoff and Brugsch, Solis-Cohen, and Strickler and Kagan. Many other observers, particularly those who have reported more recently, corroborate his findings in this disease. Among them may be mentioned Klebs, Sabrazes, Dluski, and Rospedishowski, Pottenger, Von Bonsdorf, Bushnell, and Treuholtz, and Minor and Ringer.

We have already described our method of making the Arneth count and the meaning of the indices recorded in the tables. While we appreciate the fact that the use of these indices is a marked departure from Arneth's own method, we have found from experience that they represent very accurately the main contention, *i.e.*, the shifting to the left in the nuclear blood pictures. It has been impracticable to

tabulate the details of these counts and for that reason only the indices appear and the actual percentage of cells with their different number of nuclear segments is not represented.

We feel that this in no way detracts from the practical value of the results presented, and we are anxious to emphasize our appreciation of these indices, or similar ones, as a valuable addition to the information that may be obtained from the differential leucocyte count. The more cumbersome tables of Arneth would never come into general use, but their chief clinical value is retained in the indices, which because of their definite numerical form can be easily incorporated into the results of every leucocyte count, and probably will be, as soon as their value is more generally appreciated.

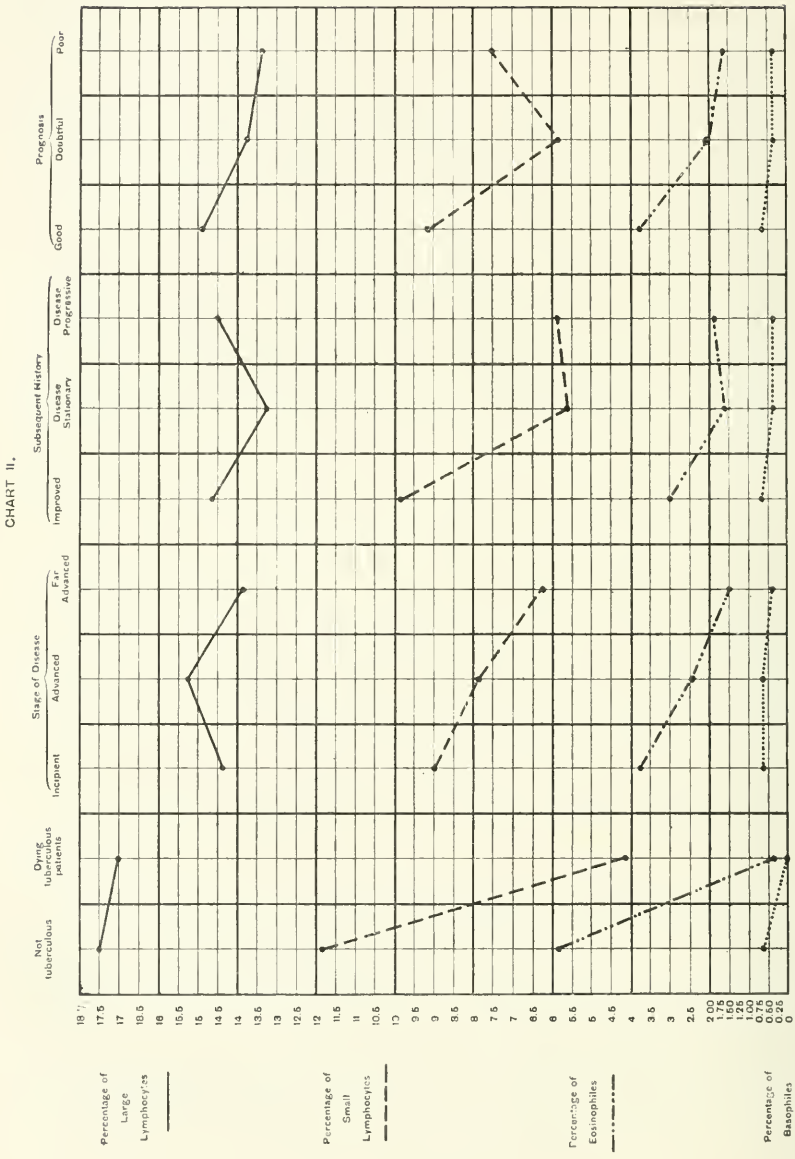
Our results are charted in Chart II, the left-hand number of the index being employed in the chart.

Our average index for the non-tuberculous cases was 54.46, and this corresponds closely with those obtained in a considerable number of observations upon normal individuals. In all other cases it will be seen that the left-hand number is much larger, and this represents the number of cells with one and two nucleus segments, plus one-half of the number having three segments. It is evident how clearly the shifting to the left is demonstrated in our observations.

The degree of shifting also becomes more marked as the cases are more advanced until an average index of 75.25 is noted in the far-advanced cases. Corresponding to this is the marked shifting noted in the cases with unfavourable prognosis and subsequent clinical course.

The relatively slight shifting in the four moribund cases is surprising. It was not to be expected from the pro-

CHART II.


Not tuberculous
Dying tuberculous patients
Stage of Disease
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Disease Progressive
Prognosis
Good
Doubtful
Poor
Percentage of Large Lymphocytes
Percentage of Small Lymphocytes
Percentage of Eosinophiles
Percentage of Basophiles

gressive shift observed in cases with unfavourable course during the period of observation. While it may be that there is a change in the nuclear blood picture shortly before death, the number of cases of this sort which we have studied is so small that no definite deductions should be drawn from them.

From the general standpoint of diagnosis and prognosis, however, we feel that in the study of the nuclear blood picture we have obtained information which is of the greatest value in tuberculosis. The changes noted are more constant than are any of the others in the blood and much more so than are many of the usual clinical signs and symptoms.

In diagnosis the field of usefulness is limited because of the comparatively slight shifting in early cases, and the fact that it may occur in other conditions when the general condition of the patient is below normal. Our experience and that of others being that the shifting to the left is simply a response to any deleterious influence in the body, especially the bacterial infections.

In prognosis, however, both at the time of original examination and during the course of the disease, the degree of shifting to the left is an exceedingly sensitive indication of the resisting powers of the individual and the progress of the disease.

We have found that cases with very slight lesions but persistently presenting an unfavourable nuclear picture, almost invariably do badly, and that, on the contrary, those with extensive lesions but fairly good nuclear picture show a marked tendency to successfully resist the disease. Moreover, during the clinical observations of a case, its real progress in one direction or the other can usually be more accurately anticipated by the changes in the nuclear picture than by any other clinical means.

Even clinical apparent cures, as Arneth well claims, are insecure unless the nuclear picture has come to nearly approach the normal, and our experience has made us very reluctant to advise a return to work and less favourable surroundings in such cases, while such return may be allowed with considerable confidence when a healthy blood picture is found.

Arneth's Blood Picture as a Guide to Specific Treatment.

Arneth claims that his blood picture is of great value both as a guide to dosage in tuberculin and also as a test for the effect of the treatment. He also considers it of value in deciding the question of the necessity for secondary courses of treatment with tuberculin. Uhl has found it of value in a similar way. Von Bonsdorf also used it as a guide for dosage, and notes a negative phase in the blood picture after tuberculin similar to that of the opsonic index. Arloing and Genty have compared the blood taken with the agglutinating power of the serum and also with the results of treatment with Maragliano's and Marmorek's sera and find a general correspondence in the results. Röver also corroborates these results with Marmorek's serum. Kaufmann, on the contrary, found no relation between the effects of Marmorek's serum, the clinical course and the changes in Arneth's blood picture.

In our own work we at first attempted to use Arneth's blood picture as a guide to tuberculin dosage, and for a while it seemed as though results were encouraging; but later experience has demonstrated to us that it is of little or no value, and that the usual clinical guides are much more consistent and delicate than any changes we have found in the leucocytes.

The Lymphocytes.

In a general way the majority of observers have noted a change in the lymphocytes inversely proportionate to the neutrophiles. In consequence, a diminishing number of lymphocytes would be considered unfavourable and an increase correspondingly favourable. Da Costa states that occasionally the leucocytosis of advanced disease is due to lymphocytes. Warthin also noted this symptom in chronic cases, as does Cabot. Arloing and Genty, Richard, Bezancon, de Jong and de Serbonnes, Halbron, Sabrazes, Steffen, Ullom, and Craig all consider that an increased percentage of lymphocytes is favourable; Steffen and Bezancon, de Jong and de Serbonnes laying especial stress upon its favourable significance during periods of improvement.

Experimentally, Achard and Loeper found that secondarily in guinea-pigs there was a lymphocytosis following a polynucleosis. Claude and Zaky found that in controls the lymphocytes were diminished and that in chronic and treated cases the large mononuclear cells were increased.

Webb and Williams lay stress upon the increase of the large mononuclears in improving cases and as an effect of altitude. They think that the beneficial effects of altitude in tuberculosis may be attributable to this increase.

In our own results we have separated the lymphocytes into the large lymphocytes and the small lymphocytes with the following results :—

The Large Lymphocytes.

The proportion of these cells which we have found in our counts is fairly constant in all stages and all degrees of progression of the disease. No apparent relationship to the clinical data can be made out from the slight variations in

percentages recorded in Table I and charted in Chart II. It would seem therefore that no clinical importance is to be attached to these cells in tuberculosis.

The Small Lymphocytes.

In sharp contrast to the large lymphocytes a very definite and interesting relationship appears to exist between the small lymphocytes and the clinical manifestations. This is apparent in Table I and is shown very graphically in Chart II. With the greater extent of lesion and the unfavourable progress of our cases there is a progressive diminution in the percentage of the small lymphocytes. In the incipient cases, those with good prognosis, those whose subsequent history shows improvement, and in the non-tuberculous cases the percentage of the cells are found to be uniformly high, varying from 9.0 per cent. to 11.8 per cent. Upon the other hand, the more advanced and unfavourable cases show percentages from 4.1 per cent. to 6.2 per cent.

The moderately advanced cases and those with doubtful prognosis standing midway between the other classes, 7.5 per cent. to 7.9 per cent. It is evident that in our cases the increased percentage of the neutrophiles in unfavourable cases has been largely at the expense of the percentages of the small lymphocytes.

The Eosinophiles.

A good deal of emphasis has been laid upon the *rôle* of the eosinophiles in the circulating blood as a guide to the clinical condition of cases of tuberculosis. In general, in acute progressive cases with secondary infection the eosinophiles have been observed to be diminished or absent and to reappear or increase during the periods of improvement and in early and favourable cases. Such is the opinion

TABLE I.

	Not tuberculous	Pulmonary Tuberculosis			Dying from tuberculosis other than pulmonary*	Prognosis			Subsequent History of Tuberculous Patients		
		Incipient	Advanced	Far advanced		Good	Doubtful	Poor	Improved	Disease stationary†	Disease progressive
Number of cases ...	9	15	30	20	4	19	18	29	17	3	26
Number of observations	37	50-54‡	91-114	91-101	8-9	62-79	77-87	84-99	60-74	18	102-121
Average number of leucocytes	10,209	9,874	10,200	13,218	26,300	9,398	11,591	12,486	9,323	12,486	13,897
Percentage of neutrophiles	64.4%	72.4%	74.0%	77.9%	78.5%	71.8%	78.0%	77.1%	71.6%	79.1%	77.3%
Average of Arneth indices	54:46	64:36	67:33	75:25	66:34	60:40	73:27	72:28	60:40	72:28	74:26
Percentage of large lymphocytes	17.5%	14.4%	15.2%	13.9%	17.1%	14.8%	13.7%	13.4%	14.9%	13.3%	14.5%
Percentage of small lymphocytes	11.8%	9.0%	7.9%	6.2%	4.1%	9.1%	5.8%	7.5%	9.9%	5.6%	5.9%
Percentage of eosinophiles	5.8%	3.7%	2.4%	1.5%	.29%	3.7%	2.0%	1.6%	3.0%	1.6%	1.86%
Percentage of basophiles	.53%	.52%	.52%	.44%	.0%	.53%	.32%	.35%	.56%	.43%	.43%

* Tuberculosis of kidney, of bladder, of psoas muscle, and acute miliary.
† Two of these were far-advanced, very chronic cases.
‡ Complete counts for every point were not invariably made.

expressed by Naegeli, Ewing, Swan, Holmes, Arloing, and Genty, Sabrazes, Cabot, Da Costa, Zappert, Galbraith, Appelbaum, Richard, Steffen, and others. Bezancon, de Jong and de Serbonnes think that the presence of the eosinophiles indicates good resisting power, and note their increase in improving cases, especially in chronic inactive cases where they consider that the tubercle bacillus lives in the body as a parasite.

Halbron states that they are diminished in advanced cases and absent in *all* cavity cases. Neusser also considers that the increase in eosinophiles denotes an immunity to the tubercle bacillus.

Webb and Williams noted a very slight decrease in advancing cases, which, however, was not distinct. Ullom and Craig, Solis-Cohen and Strickler and Craig found no relation between these cells and the clinical course of the disease. Experimentally, Claude and Zaky, and Achard and Loeper found that these cells were diminished in control cases, but reappeared subsequently if the animals lived, and in chronic cases they were increased.

Numerous authorities, including Ewing, Cabot, Bischoff, Rieder, and Bodkin note an increase in the eosinophiles after the administration of tuberculin.

Our results coincide with the majority of observers, and we have found that with the progression of the disease these cells become less and less numerous until they almost entirely disappear from the blood in the terminal stages.

Our results show 5.8 per cent. in non-tuberculous cases and 3.7 per cent. in the incipient cases and those with good prognosis. This percentage is reduced to 1.5 per cent. in the far-advanced cases, and 0.29 per cent. in the moribund cases. Chart II shows this relationship very clearly.

The Basophiles.

We have found no reference in literature as to the behaviour of the basophile leucocytes in tuberculosis. The small number of these cells found in the blood renders conclusions drawn from the count of from only 100-200 cells valueless. The indications, however, are that they do not vary appreciably in the various phases of tuberculosis and that they have no clinical significance.

Composite Tuberculosis Blood Pictures.

In order to easily appreciate the clinical significance of our findings, we have arranged them in the form of composite blood pictures for each of the more important features of the disease.

Tl. number	N.	L. L.	S. L.	E.	B.	Index
(1) *Non-tuberculous Cases* (9 cases—37 blood counts).						
10,209	64.4	17.5	11.8	5.8	0.53	54:46
(2) *Incipient Tuberculosis* (15 cases—54 counts).						
9,874	72.4	14.4	9.0	3.7	0.52	64:36
(3) *Advanced Tuberculosis* (30 cases—114 counts).						
10,200	74.0	15.2	7.9	2.4	0.52	67:33
(4) *Far Advanced Tuberculosis* (20 cases—101 counts).						
13,218	77.9	13.9	6.2	1.5	0.44	75:25
(5) *Moribund Cases* (4 cases—9 counts).						
26,300	78.5	17.1	4.1	0.29	—	66:34
(6) *Cases with Good Prognosis* (19 cases—79 counts).						
9,398	71.8	14.8	9.1	3.7	0.53	60:40
(7) *Cases with Poor Prognosis* (29 cases—99 counts).						
12,486	77.1	13.4	7.5	1.6	0.35	72:28
(8) *Cases which showed Subsequent Improvement* (17 cases—74 counts).						
9,323	71.6	14.9	9.9	3.0	0.56	60:40
(9) *Cases which Subsequently did Badly* (26 cases—121 counts).						
13,897	77.3	14.5	5.9	1.86	0.43	74:26

Pneumonia.

A review of the literature concerning the behaviour of the leucocytes during lobar pneumonia shows that the pre-

sence of leucocytosis in this disease has been recognized from the very beginning of blood examinations. Cabot states that the leucocytosis, when marked, indicates good resistance on the part of the individual or a severe infection, and that a slight leucocytosis or normal leucocyte count indicates a poor resistance or a mild infection. He considers the absence of leucocytosis a very bad sign, but its presence of no significance, either for good or bad. In 842 cases, ninety showed no leucocytosis, and of these eighty-three were fatal.

Cabot's ideas are similar to those expressed by Ewing, Naegeli, Da Costa, Buchanan, and others. Türk states that the leucocytosis bears no relation to the severity of the disease, and that if it continues after crisis it indicates delayed resolution or some complication.

Rieder states that it has no relation to the height of the fever. Von Limbeck states that the leucocytosis is in proportion to the lung involvement. This contention has been disproved by numerous observers. Von Jacksch has made a careful study, showing the importance of leucocytosis from the standpoint of prognosis and advocated artificial means to produce leucocytosis such as drugs, local abscess formation, &c. These ideas are now obsolete.

Experimental Evidence.

Tschistoritsch (quoted by Von Limbeck) experimented with guinea-pigs and found that an injection of highly virulent cultures of pneumococcus produced no leucocytosis and the animals died. Weaker cultures produced leucocytosis and the animals recovered.

Rieder inoculated guinea-pigs intraperitoneally with pneumonia sputum and obtained sub-normal leucocyte counts and subnormal temperature. Williamson, by injec-

tions of pneumococcus cultures in guinea-pigs, obtained first a leucocytosis of varying intensity followed by a diminution in the number of leucocytes. He also noted no relation between leucocytosis and the course of the disease.

Our studies of the leucocytes in pneumonia have failed to reveal the definite clinical relationships that we found in tuberculosis.

Forty cases were studied and upon these 131 separate blood counts were made. Almost the entire number were cases of lobar pneumonia, but a few of broncho-pneumonia are included. All of the observations were in adults.

In attempting to trace the connections between the blood counts and the clinical findings, we have analyzed the cases according to the extent of involvement, the clinical severity of the infection, the method of defervescence, the duration, the final results and the complications.

Our results in their relation to all of these factors are tabulated in Table II.

In addition, the observations upon the leucocytes after the acute infection was over have been studied in respect to the promptness of resolution in the lungs, and these results are also included in the table.

The Total Number of Leucocytes.

The usual leucocytosis expected in pneumonia was present in our cases, but was not as marked as is often seen. The number of leucocytes varied from 15,000 to 20,000 in all classes of cases, excepting in the series of ten cases which died, where the average of twenty-seven counts was 21,040. This is noteworthy because these results disagree with the more usual finding that a high leucocytosis indicates a good prognosis and a low one the reverse. Our series is too small to draw definite conclusions in this regard, but the results are nevertheless suggestive.

TABLE II.

Observations during Acute Illness (Lobar and Broncho Pneumonia).

Observations after Subsidence of Pneumonia.

	Involvement		Severity of Disease			Defervescence		Duration of Disease		Result			Complications		Observations after Subsidence of Pneumonia.	
	One lobe	Two lobes	Mild	Moderate	Severe	Crisis	Lysis	Up to six days inclusive	Seven days and over	Cured	Died	Delayed resolution	Empyema	Pericarditis, &c.	Good resolution	Delayed resolution
Number of cases ...	24	16	11	13	11	21	8	4	18	12	10	11	3	6	11	6
Number of observations	91-92	35-39	47-49	45-46	28-29	71-74	30-32	10	17-18	40	27	46-50	10	10-11	20	20-22
Average number of leucocytes	17,058	18,012	17,634	14,532	20,250	16,355	17,028	16,660	16,912	16,265	21,040	15,255	16,600	17,960	12,930	12,995
Percentage of neutrophiles	77.0%	76.5%	76.9%	72.9%	81.8%	74.9%	77.5%	72.1%	76.4%	77.6%	80.9%	73.3%	85.6%	72.8%	73.0%	64.4%
Average of Arneth indices	67:33	56:14	60:34	63:37	62:38	64:36	64:36	66:34	65:35	63:37	60:40	66:34	61:39	66:34	59:41	64:36
Percentage of large lymphocytes	16.8%	17.6%	16.5%	19.5%	15.0%	17.6%	17.5%	18.7%	17.4%	16.5%	15.6%	18.7%	11.3%	22.5%	19.2%	23.3%
Percentage of small lymphocytes	4.6%	4.1%	4.6%	5.3%	3.0%	5.2%	3.6%	7.8%	4.5%	4.9%	3.2%	4.9%	3.0%	3.7%	6.2%	7.3%
Percentage of eosinophiles	1.2%	1.5%	1.6%	1.8%	.08%	1.9%	.77%	1.4%	1.2%	.89%	.12%	2.4%	.008%	.66%	1.4%	3.93%
Percentage of basophiles	.27%	.23%	.25%	.42%	.03%	.23%	.48%	—	.30%	.077%	.057%	.53%	—	.26%	.10%	.77%
Percentage of myelocytes	.11%	.04%	.09%	.09%	.08%	.07%	.14%	—	.13%	—	.057%	.18%	—	—	—	.25%

The usual diminution in leucocytosis is noted after the defervescence. This is not so very marked, the counts averaging about 13,000. Most of these counts were made in the first week after defervescence and indicate a gradual return toward the normal leucocyte count.

In order to ascertain whether there was much variation in the leucocytosis of pneumonia in various years, corresponding to the rather general opinion that there is a marked difference in the virulence in this disease in various years, we have collected the records of the leucocyte count in lobar pneumonia for five years, 1904 to 1908 inclusive, of the First Medical Division of Bellevue Hospital: 514 cases are thus studied and the results are tabulated in Table III.

From these tables it does not appear that there is any very great variation in the various years, certainly none from which any valuable inference could be drawn.

These results also would not appear to corroborate the general impression that fatal cases usually have low leucocyte counts. The average for the entire 514 cases showed 20,444 for those who recovered, and 18,827 for those who died. These cases are all uncomplicated; the counts, of course, were made by numerous observers.

Differential Count.

Cabot, Ewing, Da Costa, Türk, Rieder, and others all find that the leucocytosis of pneumonia is due to the increase of the neutrophiles. Türk, who has studied the differential count in pneumonia most thoroughly states that the neutrophiles are increased in proportion to the leucocytosis; that they fall with the crisis but not with a pseudo-crisis; that the large mononuclear cells and transitionals vary with the neutrophiles; that the lymphocytes may be increased, normal, or diminished in number, but that after a crisis they

TABLE III.

Leucocyte Counts in Lobar Pneumonia (during acute illness.)

Cases which Recovered.

	1904	1905	1906	1907	1908
Counts between	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
0 and 10,000	5	15	7	7	13
11,000 ,, 20,000	41	45	33	58	52
21,000 ,, 30,000	30	38	43	28	20
31,000 ,, 40,000	22	2	15	7	13
41,000 ,, 50,000	2	0	2	0	2
Average No. of Leucocytes ...	22,501	18,375	22,865	19,243	19,208

Cases which Died.

	1904	1905	1906	1907	1908
Counts between	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
0 and 10,000	17	10	25	16	11
11,000 ,, 20,000	46	53	47	51	54
21,000 ,, 30,000	25	25	18	25	28
31,000 ,, 40,000	4	12	8	8	7
41,000 ,, 50,000	8	0	2	0	0
Average No. of Leucocytes ...	19,652	19,938	18,216	18,024	18,218

Summary for the Five Years of 514 Cases.

	Number		Percentage	
	Recovered	Died	Recovered	Died
Counts between			Per cent.	Per cent.
0 and 10,000	26	39	10	16
11,000 ,, 20,000	123	123	46	50
21,000 ,, 30,000	85	59	31	24
31,000 ,, 40,000	32	19	12	8
41,000 ,, 50,000	3	5	1	2
Total	269	245	100	100
Average No. of Leucocytes	20,444	18,827		

are usually increased; that eosinophiles are absent or few during the fever, but that their presence is favourable and that after a crisis they are distinctly increased, their reappearance in the blood often being evidence of beginning resolution. Myelocytes may appear if the infection is very acute.

Most authorities agree in general with Türk's observations. Becker states that he has never found any eosinophiles present in fatal cases. Loeper states that if the percentage of neutrophiles is over 90 per cent. the case is almost invariably fatal.

Our observations show that the neutrophiles are invariably increased, excepting after defervescence; that they vary from 72 to 77 per cent. in all classes of cases, excepting in the very severe infections, where it was 81.8 per cent. In cases which died they were 80.9 per cent., and in those complicated with empyema, 85.6 per cent.

It would appear, therefore, that an excessive increase in the percentage of neutrophiles indicates a very severe infection. In the lymphocytes our studies fail to reveal any clinical evidence of value. The percentage of large lymphocytes vary from 15 to 23.3 per cent. and the small lymphocytes from 3 to 7.3 per cent.

In the cases of severe infection the percentage of large lymphocytes was comparatively low and higher in those with delayed resolution after defervescence.

In the eosinophile cells the blood counts during the acute illness showed nothing of note, the percentage being normal throughout. In six cases of delayed resolution, however, the average percentage of these cells in twenty counts was 3.93. This moderate increase is in accord with the results of other observers in such cases and appears to have some definite relationship to the condition in the lung.

The basophiles and myelocytes were observed in very small numbers and are apparently of no clinical significance.

The Arneth Blood Picture.

Very few studies of Arneth's blood picture of pneumonia have been reported. Arneth reports on sixteen cases and notes greater variations in his blood picture between different cases of pneumonia than in any other infectious disease. There is regularly a marked shifting to the left which may come immediately with the onset or may come on gradually and increase to its highest point just before or after crisis.

Complications, according to Arneth, bring out a new and increased shifting to the left. The blood picture may return to the normal quickly, corresponding to a rapid resolution, or may continue to get worse at the time of the crisis, even though the total leucocyte count may fall.

Cases defervescing by crisis are more apt to return to normal quickly and those by lysis more slowly. In delayed resolution and chronic interstitial pneumonia, a shifting to the left with a normal or diminished leucocyte count may persist for months. Arneth draws no clinical conclusions of value from his own results.

The observations upon our cases show a moderate shifting to the left in the Arneth blood picture to be a constant factor in our cases of pneumonia. This shifting is less marked than in the more advanced cases of tuberculosis, and does not vary in any definite relation to the clinical aspects of the cases studied, the index varying from 60.40 to 67.33.

Very quickly after defervescence the index tends to go back to the normal if good resolution is established. The average index for all such cases studied was 59.41, but these counts were made usually within the two or three days after defervescence, and we have noted, in some cases, a return to absolute normal nearly coincident with the signs of complete resolution in the lungs.

In the six cases of delayed resolution, however, the average index was 64.33, showing the continuation of the shifting to the left in such cases after the fever has subsided, the whole picture in such cases being very similar to that of moderately advanced tuberculosis.

It is to be noted that the least shifting to the left of any clinical group of cases was in the ten cases who died, the average index being 60.40.

An unusual average index is noted in Table II under the group of sixteen cases with involvement of two lobes.

This average does not accurately represent the usual condition of affairs in such cases, but in this series is markedly modified by several observations upon one case, which showed a very unusual blood picture with a marked shifting to the right. This patient died and autopsy showed a marked purulent bronchitis in addition to the unresolved pneumonia.

The index above noted, 60.40, for the cases which died, is also influenced by this case, which cannot be considered as at all representative of the usual blood picture found in pneumonia.

This case is deserving of further consideration as tending to corroborate our experimental observations, that in the presence of a purulent infection the shift may be to the right and the fragmentation of the nucleus becomes very marked in a considerable number of neutrophiles, even up to seven or eight segments.

In general, we have found the determination of Arneth's blood picture of practically no clinical value in pneumonia.

The composite blood picture of pneumonia from our results would be :—

Tl. number	N.	L.L.	S.L.	E.	B.	M.	Index
17,058 ...	77	16.8 ...	4.6 ...	1.2 ...	0.27 ...	0.11 ...	67.33

The only other composite blood pictures worthy of separate notes in our findings are :—

After Defervescence with Good Resolution.

Tl. number	N.	L.L.	S.L.	E.	B.	M.	Index
12,930	63	19.2	6.2	1.4	0.1	∞	59.41

After Defervescence with Delayed Resolution.

Tl. number	N.	L.L.	S.L.	E.	B.	M.	Index
12,995	64.4	23.3	7.3	3.93	0.77	0.25	64.36

Conclusions.

(1) The study of the leucocytes gives valuable information in the prognosis and clinical course of pulmonary tuberculosis.

(2) In diagnosis of incipient cases it is of no assistance, but in differential diagnosis of whether more acute pulmonary lesions are due to tuberculosis or some other infection, it is sometimes helpful.

(3) Arneth's differential neutrophile count is important in tuberculosis. In pneumonia, while the shift to the left occurs regularly, it bears no constant relationship to the course of the disease.

(4) In general, the following changes in the leucocytes occur in cases of pulmonary tuberculosis which are progressively doing badly or are in an exacerbation of the disease :—

1. A leucocytosis.
2. An increased percentage of neutrophiles.
3. A diminished percentage of small lymphocytes.
4. A diminished percentage of eosinophiles.
5. A marked shifting to the left of Arneth's blood picture.

And, conversely, changes in the opposite direction are favourable.

(5) In pneumonia our observations have contributed no material addition to our knowledge of the behaviour of the leucocytes.

DISCUSSION.

Dr. C. L. MINOR: Since I read my paper some two years ago before the Society on this same subject I have become more than ever convinced of the great value of this method in estimating the prognosis in pulmonary tuberculosis, and I am glad to find that Dr. Miller's work corroborates these views.

In the first place, let me say that to any man used to blood work the application of this method is not difficult. Secondly, that as a guide to prognosis it will frequently be found superior to the study of physical signs and symptoms.

Again and again I have been warned of impending bad results in a case by a rise in the index, while as yet there were no signs nor symptoms to warn me.

As to what shall determine the exact index, I prefer Bushnell's method of taking the sum of all the cells in class one and two, and half those in class three, and adding them together to form the index. The index we got from our normal cases was lower than that of Dr. Miller, just as his was lower than that of Bushnell or Webb.

Further, in our severe cases, we got higher indices than he did, sometimes as high as 90 or over. Diagnostically I have not found the method valuable, and I would also note that slight variations in index are not of importance, but a persistent rise in the index is a prognostic sign of great value.

Dr. LAWRASON BROWN: I should like to congratulate Dr. Miller upon his excellent work. I might add that we have done some work with the Arneth test and found that in the majority of our cases, when the prognosis was bad, it did show a decided shifting to the left. We tried to make use of it in determining the therapeutic doses of tuberculin, but found that it was of no aid. However, during a reaction to the tuberculin test, we did find some shifting to the left. It might be of interest to add a word or two in regard to the use of averages in the discussion of statistical matters. In statistics the average is another name for the mean, while the most usual occurrence is said to be the mode. It is readily seen that the mean gives the true idea of what happens most frequently only when it approximates the mode, consequently the mean, or the average, is of value only when the curve is what might be called the normal frequency distribution curve. For any other curve the average would be very misleading.

ATYPICAL PNEUMONIA.

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Under atypical pneumonia I have chosen to include those forms of pneumonia the specific organism of which is not known. It thus practically includes all cases of pneumonia, except those produced by the pneumococcus and the tubercle bacillus, and includes cases of mixed infection, even when these organisms are present. This paper was suggested by the paucity of literature on such cases and the error frequently made in diagnosing them as tuberculosis. While I make the differentiation on the ground of the organism or organisms causing the inflammation, the diagnosis must be made chiefly clinically and from clinical signs and symptoms, because of the difficulty of isolating the causative bacteria.

Croupous pneumonia is lobar, of sudden onset, ushered in frequently with a chill, a pain in the side of the chest and prostration. At first we have a stage of congestion giving crepitant râles, then we get consolidation, the alveoli being filled with fibrine, blood and desquamated epithelium, followed in a few days, unless death intervenes, by softening. We then get many moist râles and resolution. The course of the disease is characterized by a bloody expectoration, nearly uniform high temperature, until resolution begins, by dullness, bronchial breathing, increased transmission of voice sounds, and sometimes a transient

bronchophony, the whole process occupying from one to four weeks. Resolution is usually ushered in by a crisis, though recovery may be by lysis.

Tuberculous pneumonia develops usually with a pre-existing pulmonary tuberculosis. It gives consolidation over a considerable area, gradually extending as the disease progresses. The alveoli and smaller bronchi are occluded, caseation and usually breaking down of the lung tissue follows if the patient lives long. Tubercle bacilli are frequently present in the sputum before the pneumonia develops; if not, except in rare cases, they soon appear.

(Broncho-pneumonia is not included in this paper.)

Atypical pneumonia is more insidious in its onset than croupous pneumonia, unless caused by some infection secondary to a pneumococcus infection. These pneumonias are seen in the aged, in alcoholics, as post-operative pneumonias, as associated with typhoid fever, with heart disease, with nephritis, in the tuberculous, or in any condition in which the natural resistance of the body has been lessened, although it may occur in strong individuals as well as in weakened ones.

In atypical pneumonia, as compared with pneumococcus pneumonia, the fever lasts much longer; the termination is by lysis, or in abscess formation, or chronic pneumonia, or other secondary pathological conditions of the lungs, and there are complications not met with in pure pneumococcus pneumonia (or the disease may itself be secondary to some other diseased condition). In its onset a chill is not usual; there is more likely to be a prodromal stage; the temperature is not so regular, usually not so high; herpes labialis is absent; the spleen is frequently enlarged, and it is more likely to be of epidemic form. No regular course of atypical pneumonia can be given because, as the name "atypical"

indicates, there is no regular course. In time, I believe, improved methods of diagnosis will remove many of these cases from the category of atypical pneumonia. I shall confine my discussion chiefly to a series of cases I have observed.

Case No. 1, Mrs. J. W. M., 37 years of age, born in England, began to feel poorly about September 1, 1908. The case was diagnosed as tuberculosis, and I saw her in consultation with the attending physician after the disease had been running about three weeks. The temperature was not high, there was no marked prostration, there was considerable cough and slight expectoration, but no tubercle bacilli were present. The physical signs were a consolidation over the left lower lobe, giving marked dullness, bronchial breathing, some broncophony with practically no râles. The condition remained about the same for a number of weeks. I took care of her while the attending physician was on a vacation. The temperature came down to normal and the strength markedly improved, so that she was doing her housework and feeling perfectly well while the signs of consolidation still persisted. An examination, November 2, 1908, gave a few fine râles over the lower left back, otherwise negative. I have examined her again recently, over three years later, and the chest is perfectly normal.

Case No. 2. F. T. E., a boy 16 years of age, attending school. His mother died of tuberculosis fifteen years ago. Family history otherwise negative. He was sent to me by another physician, September 12, 1910, with a diagnosis of pulmonary tuberculosis, he having found trouble in the upper part of one lung a few days before. The boy claimed to have been feeling well until very recently. For a short time he had been losing flesh rapidly. He had a cough with slight expectoration. Examination showed some dullness

and harsh breathing at the left apex, dullness over the whole right side, flatness at the right base, bronchial breathing with increased transmission of voice sounds over the middle and upper lobes of the right lung, suppressed respiration over the right lower lobe, and bronchophony between the angle of the right scapula and the spine. At this time he also had a sore throat, the bowels were moving five to six times a day, watery movements, but no pain or gas, and the mouth and throat were covered with a white coating like aphthous stomatitis. Temperature, 101.5° F. Two days later the signs of consolidation over the right lower lobe were more marked and there were coarse moist râles at the base. On the 17th there were bubbling râles and bronchophony below and back of the angle of the right scapula, the bronchophony being over a larger area than at first. Up to this time the prostration was extreme and I was deceived into believing that we had a tuberculous process with a mixed infection and rapidly forming cavity in the right lung. On September 24, while the examination was about as on the 17th, the stomach and bowels were in good condition, the temperature was 99°, and the pulse 82, though there had been nothing resembling a crisis. From this time on his general condition improved steadily. The temperature became normal about three weeks from the time I first saw him and he gained weight. On December 14, three months from the onset, the left lung had become clear, the resonance over the upper part of the right lung had improved, the apparent cavity had grown smaller and the bronchial breathing was limited to an area along the spine from the middle of the scapula to the base of the lung. There were coarse, moist râles at the right base, back. On December 28 the boy had gained 16 lb., was feeling perfectly well, and looked a picture of health, but there was still

bronchial breathing and some bronchophony over the right lower back, lower down than where the bronchophony first appeared. There were very few breath sounds over the anterior half of the right lower lobe.

I did not see this boy again until May 27, 1911, when he was brought to me at my request. He had felt perfectly well in every way, had attended school, and, acting on his own impulse, had joined a baseball nine, and was pitching ball for the nine. Examination showed dullness, bronchial breathing, marked increase in transmission of spoken and whispered voice sounds, and some moist râles at the right base; some retraction, broncho-vesicular respiration, moist râles and increased transmission of voice and heart sounds over the right front of chest.

Case No. 3. Mr. A. E. H., 42 years of age, foreman in a manufacturing jeweller's establishment. He had felt poorly for some months, and very poorly for about three weeks, when he consulted his physician, December 18, 1910. At that time the symptoms resembled typhoid, the temperature ran from 101° to 103° F., there was a good deal of nose bleed, almost no cough, much disturbance of the digestion, and the general appearance that of a very sick man. He had an attack of pleurisy about December 22, the pain of which lasted for several days. About January 1, with considerable difficulty, sufficient sputum was obtained for examination and tubercle bacilli were found. I saw him first January 7, 1911. As that time the back of the right chest was flat from a little above the angle of the scapula to the base. The resonance in front was fairly good. Over the flat area there was bronchial breathing and the bronchophony was marked. The whispered sounds were as distinct as I have ever heard them over a large cavity. The pulse was then rapid, about 120, though the attending physician said

that the heart had previously been in good condition. The man was apparently dying from phthisis florida, but I believed that not all of this consolidation was due to pulmonary tuberculosis, because I have never seen and cannot conceive of a tuberculous pneumonia in which all of the smaller bronchi were open so as to admit air to the lung, as air was evidently admitted to this lung. At the urgent request of the attending physician I took charge of the case and have attended it since. Through January, February, and March there was gradual improvement. By the middle of February the temperature rarely went above 100° F., the appetite and the digestion were good, and the patient said he never felt better in his life. The signs in the chest, however, remained nearly the same, except for a few fine râles at the upper part of the consolidated area. At this time the chest began to clear, the resonance improved over the upper part of the affected area, and the whispered voice was not transmitted as distinctly, but the improvement in the lung was extremely slow. Three months from the time I first saw him the temperature rarely went above 99° F., though the pulse steadily remained between 100 and 110. The patient was sitting up and walking about the house, was feeling strong, and had gained so much that he was unable to button about him the clothes he had worn before being sick. The signs in the chest, however, still persisted, though they were much less intense.

The temperature was normal until May 8, when it began to go up to 100° F. at night, and he did not feel as well. Examination, May 10, gave signs of fluid at the right base. May 11, twenty-four ounces of fluid, specific gravity 1022, and highly albuminous, were withdrawn. The needle struck a lung apparently as firm as a liver. In ten days the temperature was again normal and thus far has remained so.

Examination now gives a friction rub over the front of the right chest, with moist râles, apparently pleural, below this to the base; dullness, bronchial breathing, bronchophony, but diminished tactile fremitus over the right back. The heart beats 110 per minute. He does not mind slow movements, but gets out of breath if he hastens any.

Case No. 4. Miss A. G., 36 years of age, had had tuberculosis for two years, but was doing her work as a dressmaker as an arrested case, although she had always complained of a feeling of distress under the right clavicle near the sternum. February 27, 1910, she spit up a half-cupful of foul-smelling pus, which seemed to come from under the first rib on the right near the sternum. The sensation of discomfort which she had felt in this area for some months disappeared, but she continued to have a foul expectoration. The latter part of March mucous râles appeared over the whole right lung and the right lower lobe became solid. The expectoration became free and a cavity formed in a very short time. She was of a nervous temperament and had had a very severe paroxysmal cough at frequent intervals since the disease first started. After the formation of the cavity the disease ran a prolonged course, common to chronic pulmonary tuberculosis. At no time in the course of the disease was the sputum free from tubercle bacilli. In this case I believe that we had a pneumonia from a mixed infection, in which tubercle bacilli bore a prominent part.

Case No. 5. N. R. H., 43 years of age, a physician, had been working hard, and for several weeks was markedly debilitated, so that his work was a great effort. About February 1, 1911, he had an attack of the grip, with marked prostration, extreme digestive disturbances, including meteorism and constipation. Albumen was found in his

urine, and a diagnosis of nephritis was made. When I first saw him (February 14) he was very nervous, was vomiting and distended with gas. He was very uncomfortable, and referred his discomfort chiefly to the abdomen, but complained of pain in the left side of his chest. The temperature was about 102° F., the pulse 100 and very feeble, and the respirations 30. He had a paroxysmal cough, with some expectoration, which at times was bloody, typical pneumonic sputum; at other times no blood was present. The bloody sputum lasted but a few days. Examination of the chest gave flatness, diminished breath-sounds and diminished transmission of voice-sounds over the left base. Between the angle of the left scapula and the spine there was dullness and broncho-vesicular breathing, with increased transmission of voice-sounds. In a few days the percussion note over the left axillary region improved, fine, moist râles (apparently pleural) appeared, the area of broncho-vesicular breathing in the back extended downward, and there was an increase in the transmission of voice-sounds. He gained strength, the pulse gradually improved, and the stomach was better. There was a slow improvement of the sounds in the chest, the quality of the sounds remaining about the same. The temperature gradually came down to normal in the morning, but remained from 100° F. to 101° F. much of the time in the afternoon until April 16, when I again found the signs practically the same as on the first examination, and found that for two days he had been feeling poorly, and that there had been some return of the digestive disturbance.

A needle was inserted and pus obtained. I then resected a rib and drained the pleural cavity. A large jelly-like mass of fibrinous exudate was also found. This was broken up and removed. The temperature immediately fell to

normal, and has remained so. Cultures of the pus gave the pneumococcus and staphylococcus. To-day there is apparently no consolidation of the lung, but it has not expanded to my satisfaction.

I did not see any of these cases, except No. 4, at the beginning, as they came to my observation as cases of tuberculosis, this being the diagnosis usually made in the earlier course of the disease, and "probably tuberculosis" is a reasonable diagnosis to make. The medical profession has been, and is, criticized for not making the diagnosis of tuberculosis earlier. As a result of this criticism all cases of obscure lung disease are called tuberculosis. The diagnosis of tuberculosis is also given to cases presenting slight localized auscultatory or percussional variations in the lungs, which are temporary in duration, and which are due to causes other than tuberculosis or to normal muscular or other variations. Dr. Bonney states that a large proportion of the cases now coming to him, sent to Denver for tuberculosis, are not tuberculous.

The diagnosis of tuberculosis is often very difficult, and by calling all doubtful cases tuberculosis many brilliant diagnoses are made, but this is not scientific, and is hard on many who do not have tuberculosis. Too careful examinations cannot, of course, be made, but too hasty diagnoses can be and are made.

It is hard to determine the organism causing these pneumonias by present methods. Examination of the sputum while the person is living is liable to marked error, because of contamination of the sputum in the bronchial tubes and throat, as the secretion is churned by the air, breathed in and out; or, as in two of my cases, there may be insufficient sputum for a satisfactory examination. Examination of the lungs after death is also uncertain in

many cases, because bacteria in the mouth and throat are disseminated throughout the lungs after death occurs. This has been shown experimentally by placing bacteria foreign to the lungs in the mouths of patients after death, and finding them spread throughout the lungs at autopsy.

The organisms most commonly found in atypical pneumonia are the streptococcus, the staphylococcus, the pseudo-diphtheria bacillus, the influenza bacillus, the colon bacillus, the bacillus pyocyaneus, and Finkler reports a diplococcus, not identical with Fränkel's.

The pathological conditions differ widely, as the causative agents differ, and with the age of the lesion and probably with the age and previous condition of the patient, so that I have found no two authors, who have described atypical pneumonia, agreeing on the pathological anatomy. Aufrecht, in Nothnagel's "System of Medicine," states that "In atypical pneumonia the lumina of the smallest bronchi are open. The smallest vessels and their capillaries appear almost empty in microscopical preparations. . . . The pulmonary tissue of one or more lobes is uniformly diseased, and only in the further course of the disease do changes occur in special areas or in the form of isolated foci." In this form there is no fibrin in the alveolar spaces during the entire course of the disease.

In case No. 3 tubercle bacilli were present, but to my mind were no important element in the pneumonic process. Had they been an active agent, the case would have followed the course of case No. 4, which is a picture so commonly seen in tuberculosis. Tuberculous pneumonia does not get well. It is not long before the formation of tubercles prevents the entrance of air into the affected part of the lung, and the process goes on to caseation and breaking down of the lung tissue with cavity formation, the process being all

the more rapid if there is a mixed infection. While we may for a long time get the indication of a lobar pneumonia, we do not get the persistent signs of consolidation, with air entering the consolidated area, marked bronchophony, no râles, and practically no sputum, as in case No. 3. It was for this reason that while the disease was at its height in this case I did not give an absolutely fatal prognosis, and is why I stated that the whole process was not tuberculous. At no time in the course of the disease was there sufficient sputum for a satisfactory examination, except by collecting the full amount for twenty-four hours, and this was chiefly clear mucus. There were no masses which could be washed in sterile water and then examined. Smear preparations showed a diplococcus, a coccus with a tendency to grow in chains, and a short bacillus.

Case No. 4 had a severe paroxysmal cough, and to my mind the pneumonic process was a direct result of the aspiration into a previously healthy part of the lung of the pus from an abscess in the upper part of the lung, this pus containing tubercle bacilli and other organisms.

In all of the first three cases the cough and the sputum entirely disappeared long before the pneumonic signs in the lung cleared up.

DISCUSSION.

Dr. J. H. ELLIOTT: In the early stages of acute pleural effusion we frequently find bronchial or tubular breathing and pectoriloquy, and it is not infrequent to make a mistaken diagnosis of pneumonia where we have this pleural effusion. We know how often these physical signs occur.

Dr. CLEAVELAND FLOYD: There is a group of cases due to the influenza bacillus which present all the signs and symptoms of pneumonia and are frequently put down as tubercular and have been sent to sanatoriums as such. Prolonged observation is often necessary in order to come to a correct diagnosis. Pulmonary hæmorrhage is often persistent in these cases.

CROTALIN IN THE TREATMENT OF PULMONARY GANGRENE.

BY THOMAS J. MAYS, M.D.,
PHILADELPHIA, PA.

It is not necessary to remind you that pulmonary gangrene is a rare affection—invariably secondary in nature—following in the trail of acute pneumonia, typhoid fever, phthisis, diabetes, insanity, &c., and that recoveries from it are exceedingly rare. Its rate of death is said to be from 80 per cent. to 90 per cent. Owing to the rarity of this disease, and on account of the unexpected recovery of a case of this kind while receiving a comparatively unknown drug, I beg your indulgence for briefly reporting the following experience:—

On December 13, 1910, I saw in consultation a male, aged 38, who five days previously had a severe chill, and was then suffering from consolidation of right lung in middle region posteriorly, with cough, brown bloody expectoration, morning temperature of 103° F., pulse 114, respiration 40 to 50, great restlessness, and muttering delirium. His abdomen was distended, and all the symptoms and physical signs indicated a case of acute lobar pneumonia complicated with typhoid fever. On the 17th he had a severe hæmorrhage from the bowels—amounting to at least a quart—and vomited about 4 oz. of blood-coloured mucus, and his breathing was very laboured and shallow, and his pulse irregular. The bleeding from the bowels continued at frequent intervals, and was accompanied

by diarrhœa. On the 20th rose-coloured spots appeared on the abdomen, and his temperature fluctuated between 101° and 104° F. The diarrhœa, bloody stools, and rusty expectoration continued, and in the beginning of January he began to cough a great deal more, and to expectorate a large quantity of yellow tenacious mucus, which soon became putrid, and was accompanied by a very offensive breath. At this stage the case gave every evidence of a very critical condition. The patient was much exsanguinated, greatly emaciated, subject to picking at bed-clothes, had a low muttering delirium, and showed all the symptoms of pulmonary gangrene.

In addition to the other internal treatment which he had so far received, and which consisted of strychnine, quinine, iron, atropine, morphine, &c., he was now given crotalin hypodermically in the forearms on the following dates: January 13 and 15, 1/200 gr.; 18th, 1/100 gr.; 20th, 1/75 gr.; 29th, 1/50 gr.; February 2, 1/50 gr.; 4th, 1/45 gr.; 6th, 1/45 gr.; 8th, 1/50 gr.; 10th, 1/45 gr.; 12th, 1/45 gr.; 14th, 1/35 gr.; 16th, 1/35 gr.; 18th, 1/35 gr.; 20th, 1/35 gr.; 24th, 1/50 gr.; and 27th, 1/50 gr.

There was no apparent improvement after the first four doses, the last two of which were given at rather a long interval, but there was a gain in his whole condition after the crotalin was resumed regularly every other day on and after January 29. His cough, expectoration, delirium, sleeplessness, pulse, temperature, respiration, and strength showed signs of improvement, and his appetite really became ravenous. From that time on his convalescence went on uninterruptedly. On February 9 he sat up in bed, and on March 1 he was able to go to Atlantic City. By April 27 he had regained his former weight (147½ lb.) entirely, and felt as well as he ever did.

Although the writer had no personal experience with the use of crotalin in this disease, and for this reason he had some hesitation in suggesting it to the attending physician in this case, he was moved to do so by reason of having read a contribution on this subject by Dr. R. E. Kinlock, of Brooklyn, New York, which appeared in the November (1910) number of *American Journal of Clinical Medicine*, describing the treatment of a desperate case of pulmonary gangrene with this agent, and of which the following is a brief summary:—

Male, age 61, merchant, had an unresolved grip pneumonia, dating from October, 1909, and previous to Dr. Kinlock's first visit, December 20, he had been attended by several physicians, who were agreed as to the diagnosis, and all gave an unfavourable opinion of the case. The patient was very much exhausted and emaciated, face drawn, anxious expression, delirious, his breathing was short and catchy, breath exceedingly foul; he talked with great difficulty, had constant cough, and the odour of the room was putrid. His temperature was 102.5° F., pulse 118, and respiration 42.

Besides a nourishing diet, strychnine, alcohol, creosote, and codeine were prescribed, and additionally 1/200 gr. of crotalin was given in the arm on the first visit. The same dose of crotalin was repeated every second day for the first week, at the end of which the pulse and temperature remained the same, but the appetite, respiration, and mental condition showed marked change for the better. The injections of crotalin were continued every second day, but increased to 1/100 gr. each dose. With the fourth week marked improvement came in every way. The temperature came down gradually, and the strength increased. More nourishment was taken, and the patient acquired an interest in life. The

fifth week he was allowed to sit up a part of the day. Expectoration grew less, and the odour had now nearly disappeared. During and after the sixth week the crotalin was increased to 1/50 gr. every second day. From this time on he made a complete recovery.

The foregoing experience indicates that crotalin deserves further attention in the treatment of pulmonary gangrene, and the writer trusts that this contribution, meagre as it is, will furnish an incentive to others to investigate the action of this drug in a disease in which it must be confessed that medication has been found of very little value.

PHYSICAL EXERCISE AND BLOOD-PRESSURE.

BY EDWARD O. OTIS, M.D.,
BOSTON.

My attention was first called to this subject while making a physical examination of members of a large men's gymnasium. The men were young or middle-aged, with one or two exceptions, and the great majority of them were engaged in indoor sedentary occupations. The exercise was taken as a recreative, hygienic measure, and consisted, for the most part, of the well-known class work, done to music, embracing pulley weights, free hand, dumb-bell, bar-bell, and Indian-club exercises, marching, dancing, deep breathing, and, finally, a sharp run; lasting altogether from half to three-quarters of an hour.

It occurred to me that perhaps, by means of the systolic blood-pressure, taken at three periods, namely, just before, immediately after, and then a little later after a short rest or after the usual bath, I could thereby obtain some definite idea of the effect of the exercise in each individual case, and thus have some practical guide as to the amount and severity of the work best suited to each person. Even the ordinary class work arranged for the average individual might be too severe for some, and, consequently, defeat the purpose for which it was taken as a recreative measure. Of course I recognized that other elements besides the blood-pressure entered into the problem and must be considered, but it seemed to me that the blood-pressure might be one test,

of a definite character, which would be of practical value in determining the proper exercise and the amount for each person. I accordingly took the maximum blood-pressure at the three periods mentioned of fifty-nine men, six boys, and, through the kind permission of Dr. Sargent, of Cambridge, of thirty-two young women, pupils in the Sargent Normal School of Physical Education. In addition, I took the blood-pressure of the first two periods, just before and immediately after exercise, of twenty-nine men, making, altogether, rather over 350 separate measurements.

I found it no easy matter to make these observations, for my material was not always as tractable as the inert or inarticulate subject of the laboratory. Sometimes after one or two measurements the man would disappear and the observation would be left incomplete. Again, I found more or less difficulty in getting the men before they had taken any exercise at all; and immediately after exercise a number of men would appear at the same moment for the second measurement, so that all could not be taken soon enough to make it of the most value. I found I could hold the men best by telling them, at the time of the initial measurement, that I could give them no idea as to how their heart was working until I obtained all three measurements. With the girls it was different, for they were more directly subject to the order of the director of the school, and, in general, they showed rather more intelligent interest.

The measurements were taken with a "Tycos" sphygmomanometer which I had compared with a mercurial instrument and found to be substantially in agreement with it. I found this instrument exceedingly useful for this work, for the measurements had to be taken rapidly, which the "Tycos" enabled me to do.

When I began these investigations I was unaware that

so much work had been done upon the effects of muscular effort on blood-pressure, both by American and foreign investigators, and I am indebted to my colleague, Professor Dearborn, for a bibliography upon the subject. Much of the work done by others, however, relates to the effect of severe, extreme exertions upon the blood-pressure, while my investigations have to do only with moderate, comparatively mild exercise as illustrated by class work, or with a short, sharp effort, like running up and down stairs, or a few laps on the running track of the gymnasium. In all the investigations, those of my own and others, practically the same results have been obtained as regards the variations of the blood-pressure before, during and after exercise, depending upon the character, length and intensity of the exercise. In brief, after prolonged and severe exertion there is a diminution of blood-pressure from the normal at the conclusion of of the effort. Thus, Baldes, Heichelheim, and Metzger (*Münchener medizinisher Wochenschrift*, September, 1906, No. 38, p. 1865) examined twelve young men between the ages of 17 and 27, after a forced march of 100 kilometres, and found in all a diminution of blood-pressure. Gordon ("Observations on the Effect of Prolonged and Severe Exertion on the Blood-pressure in Healthy Athletes," G. A. Gordon, M.B., *Edinburgh Medical Journal*, 1907, 22, p. 53) took the blood-pressure of two football players in an International Rugby football match, and found a marked fall in both cases. Potter and Harrington ("Medical Supervision of Athletics among Boys at Boarding Schools," *Journal of the American Medical Association*, 1909, 53, p. 195) found that in ten Marathon runners all exhibited a low blood-pressure after the race, except one, who was the winner and who had a pressure of 160 after and 120 before. Three were examined before and after

another race, and in the examination after the race all showed a blood-pressure below 105, while before it was 140. Barach ("Physiological and Pathological Effects of Severe Exertion"—The Marathon Race—*Archives of Internal Medicine*, 1910, p. 382) found in fifty-five Marathon race contestants that the maximum blood-pressure before the race was 126.5 (fifty-three cases) and 107.3 (thirty-eight cases) after the race. Ten days subsequently to the race the pressure was 124.7 (nineteen cases). Lowsley (*The American Journal of Physiology*, 1911, vol. xxvii., No. 5, p. 446), after a twenty-mile race, found the blood-pressure below normal, and his conclusions are that "rapid exercises (vigorous, fatiguing, exhaustive) are followed by a fall of pressure below normal, which lasts longer than after moderate exercise, even if the former is continued for a very short period and the latter for quite a long period of time; furthermore, the return to the normal pressure after the subnormal phase is slower the more exhaustive the exercise."

On the contrary, after a short period of mild or moderately severe exercise, as in class work, the blood-pressure taken immediately at the conclusion of the exercise shows, in the majority of cases, a rise, followed quickly by a fall to or near normal or to subnormal, as indicated by my results and those of others. In the exceptional cases, when this does not occur, it may indicate that for these cases either the exercise, however mild it may seem, is too severe, or that it was taken in an exhausted condition, or, on the other hand, those taking it were so well trained that the blood-pressure was little, if any, influenced. Thus Pembery and Todd (*Journal of Physiology*, 1908, 37, p. 66) found that with two men running up and down stairs, the one trained and the other untrained, the former showed a smaller rise and a more rapid recovery than in the case of the untrained

man. Gordon (*Edinburgh Medical Journal*, 1907, 22, p. 53) narrates an interesting incident illustrating the effect of training in the case of the champion club swinger of the world, Tom Burrows by name, 38 years old, a teacher of club swinging, swinging his clubs, weighing together three pounds, twelve hours continuously for six successive days. Readings of the blood-pressure were taken daily before and after the twelve hours' swing, and on every occasion a rise of blood-pressure was found at the close of his day's work, in one case the increase being 15 mm. Hg. This was apparently a case of light exercise long continued, by a perfectly trained man, in which the fatigue point was never reached, a little better than an equilibrium between fatigue and recovery. Nos. 71 and 75 appear also to illustrate this fact of the effect of training.

These reasons, however, do not explain all the exceptional cases. Probably the size of the heart and its integrity, the condition of the nervous system, the elasticity of the arteries, the habits and artificial influences, like alcohol and tobacco, the age, weight, and perhaps the mental state of the individual, are other reasons. In interpreting the variations of the blood-pressure under physical exercise, all the conditions of the individual and his environment must be taken into account, it seems to me, and these conditions are so complex and occult that we cannot yet wholly dissociate them or give each its true value.

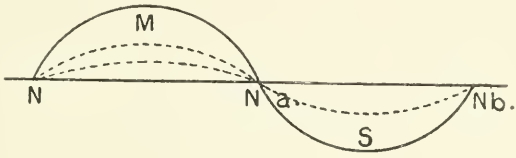
In my 126 cases of moderate general exercise, a mixture of various kinds, as in class work, ninety-seven, or 77 per cent., showed a rise of blood-pressure immediately after the exercise. In nine, or 8.1 per cent., there was no difference between the first and second measurement; and in twenty cases, or 16 per cent., there was a fall in the second measurement. With the third test taken from three to twenty

minutes after the exercise, in some cases after a simple rest and in others after the bath, out of fifty-nine men, forty-five, or 76 per cent., showed either a fall to the initial measurement (supposedly the normal) or a subnormal pressure, generally the latter. Of course, there is the possibility of error in the two latter measurements, the second and the third, in that the initial blood-pressure might have been above the normal from some exercise taken previously of which I was unaware, for it was difficult to always get the men perfectly fresh from a state of rest.

Reasons for these exceptional cases have already been suggested. To formulate, then, the results I have obtained as well as those of other investigators, one may say that physical exercise in the majority of cases, of whatever nature it may be, excessive, severe and long continued, or more gentle and moderate, causes a rise in the systolic blood-pressure, the maximum occurring some time during the effort. As fatigue sets in and advances, the pressure falls to normal or subnormal. "A maximum systolic pressure," says Lowsley, "is reached more rapidly in the case of a fatigued individual, but it is not nearly so extensive." If the exercise ceases at a time when the increased pressure exists, which is indicated by taking it immediately upon stopping exercise, the return towards the normal takes place rapidly, generally within a comparatively few minutes, as was the case with my observations. Or, if it ceases after the fall to subnormal has occurred, as in the case of more extensive, fatiguing and long-continued exertion, then the return *upward* to the normal is slower, depending upon the degree of fatigue and exhaustion. Lowsley considers the subnormal phase following the exercise as an important indication of the effect of the exercise upon the individual. "When," he says, "the subnormal phase returns to normal

within sixty minutes the exercise may be considered as lying well within hygienic limits for that individual; while a return that is delayed beyond 120 minutes may be regarded as exceeding these limits."

We may represent graphically the various phases of the blood-pressure during and after physical exercise by a double curve, as follows:—



Starting from the normal (N) for each individual and rising until the maximum (M) is reached, at a greater or lesser height; remaining there for a greater or lesser time, according to the strength of the individual for sustained work, his condition of freshness or fatigue and his degree of training; then, as fatigue begins and increases, falling and continuing to fall until the normal (Na) and subnormal (S) point is reached; and, finally, after cessation of the exercise and rest, a return more or less rapidly, depending on the degree of fatigue, to normal again (Nb).

As will be seen, the majority of my cases (77-76 per cent.) represent what might be called the normal (using for the moment the word in another sense) and safe curve of exercise or physical exertion, namely, starting with the normal blood-pressure; ending at or near the maximum, and then shortly—in a comparatively few minutes—returning to or near the normal again; it may be a little above or a little below; when this curve is obtained we may say that the exercise or effort is well within the strength of the individual. In certain cases, as I have already indicated, this curve

may approximate to a straight line, or only the second curve, the fall from normal to subnormal and rise to normal again, is found. The blood-pressure taken then at any period of time during the formation of this double curve would appear to give some indication of the condition of the individual in relation to the exercise he is taking, and hence serve as a guide as to the suitability of the exercise, both as regards severity and time extent, or as regards his condition at the time of taking the exercise.

If, for example, immediately after exercise the blood-pressure is subnormal and remains so for some time, as in the case of the Marathon runners and football players, or in any case, even if the exercise is moderate and not long continued, such as class work, then for that individual, or for his condition at the time of taking the exercise, we may consider it too strenuous or too prolonged. To illustrate this I will refer to No. 100 of my measurements. This was a merchant, 62 years old, of delicate build, who, after his day's work, took the class exercise. His initial blood-pressure was 138, and immediately after his exercise it was 118, and he looked overworked and tired. It would appear to be a fair assumption that he was in a condition of fatigue at the commencement of his exercise, and hence what he needed was rest and not physical effort. Nos. 34, 47, and 107 seem to be similar cases. In other cases the subnormal second measurement might be explained by the fact that the individual was untrained, and, therefore, more quickly reached the fatigue point. This may have been the case with the three police officers, Nos. 58, 59, and 86, who, after an hour's rather strenuous exercise at handball, showed a subnormal pressure. The case of the two boys, brothers, Nos. 92 and 93, is rather interesting. No. 92, though smaller and younger than No. 93, has always shown more

endurance and vitality than his older brother; and I think the blood-pressure measurements would give some indication of this fact, for, at the close of the same class work, the older showed only 3 mm. Hg. rise in pressure, while with the younger it was 10 mm. Hg. Evidently one reached the fatigue point more quickly than the other. Furthermore, the last measurement after a bath showed a lower or at least a more lasting subnormal point in No. 93 than in No. 92.

The case of the thirty-two young women is interesting and suggestive. In the first place it will be seen that all, from No. 16 to No. 32 inclusive, seventeen cases, who made the short, severe exertion of running up and down stairs, or a rapid run around the track, showed, with one exception, a very much increased blood-pressure immediately after their effort, which pressure fell, in from three to eight minutes, to subnormal in eleven cases, and at or a little above normal in the other six. While, with the other fifteen girls who took class work of one kind or another, nine showed a slight rise of blood-pressure immediately after the exercise, four a slight fall, and two no change. Ten minutes after the exercise, eleven showed a fall to subnormal, two were above normal, and two normal. It seems to me that a fair interpretation of the comparatively slight variations in the blood-pressure of these last fifteen girls is that they were well trained, taking regular, systematic exercise daily, and, further, that they had frequent short rests during the class work. Doubtless other inferences will suggest themselves from this series of observations, but from what has already been shown, it seems to me to be a fair deduction that, taken in connection with other knowledge of the individual—his physical condition, habits, age, training, &c.—the blood-pressure, taken at the three periods mentioned, may be a valuable guide and aid in apportioning the proper amount

of physical exercise to the individual, particularly when it can be so delicately applied as to force, time, and variety, as in gymnasium work under skilled supervision. Furthermore, by means of the indications given by the blood-pressure, we may be enabled to avoid injury from excess, or from exercise unsuited to the individual.

Anything so sensitive to stimuli and perturbing influences, both within and without, as the blood-pressure must, of course, be subject to wide variations, and, therefore, we cannot expect it to be an accurate guide, but rather an aid of considerable value when taken in connection with other evidence. Panchon (*Comptes-rendus de la Société de Biologie*, May, 1910), who has published a series of observations upon the maximum and minimum blood-pressure (the systolic and diastolic) taken by an instrument of his own device, which he calls the "Oscillometer," declares that the variations of the arterial pressure are valuable criteria in the application of physical exercise, and by them one can make a choice both of the kind and amount of exercise proper for each particular case. "The sphygmomanometric study," he continues, "constitutes a very sensitive criterion of the endurance of the organism during physical work." And with Gallic enthusiasm he declares that such criteria ought to be applied wherever there is human activity, not only in the case of physical culture, but as well in industrial life, especially where the work ought to be exactly adapted to the endurance of the individual. Whether or not this French savant had ever heard of the present popular "scientific management" of industries, I do not know, but at any rate his observations are suggestive in this direction, and it would appear reasonable and be an interesting study to apply his criteria, viz., the blood-pressure measurements, to the working man if thereby we might more accurately

determine his fatigue point, and apportion his work accordingly, and thus both conserve his energy and obtain his maximum efficiency.

I desire to express my obligations to Dr. Sargent, Director of the Sargent Normal School of Physical Education, in Cambridge, to Mr. Hibbard and his assistant, Mr. Browning, of the Young Men's Christian Union Gymnasium, and to Messrs. Roberts and Caswell, of the Young Men's Christian Association Gymnasium, both of Boston, for the very valuable aid they rendered me in making these observations.

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Blood-pressure and Physical Exercise.

Girls of the Sargent Normal School of Physical Education.

No.	Name	Age	Occupation	Form of exercise	Blood-pressure before exercise	Immediately after exercise	After rest from three to twenty minutes	Remarks
1	E. R. ..	20	Student	Class-work with intervals of rest	100	115	Ten min. after exercise 95	
2	E. C. ...	21	,,	Class-work with intervals of rest	114	117	100	The same girl after she had run up and down four flights of stairs had a blood-pressure of 114, 140, 120.
3	N. H. ...	19	,,	Clubs and balls	100	115	100	
4	E. P. ...	21	,,	Class-work	125	136	118	
5	C. P. ...	22	,,	,,	120	Five min. after 117	113	After short violent exercise the blood-pressure was 150.
6	H. B. ...	23	,,	,,	125	Five min. after 115	112	After short violent exercise the blood-pressure was 150.
7	L. T. ...	19	,,	,,	100	115	88	
8	L. G. ...	22	,,	,,	90	115	114	
9	H. B. ...	23	,,	Dancing	114	100	100	The second blood-pressure was taken after violent dancing and the third two minutes later.
10	E. G. ..	27	,,	,,	90	100	88	The second blood-pressure was taken after violent dancing.
11	D. R. ...	21	,,	,,	115	114	117	
12	I. T. ..	22	,,	,,	94	94	94	
13	L. C. ...	21	,,	Bounding balls	90	95	85	
14	E. B. ..	19	,,	Dancing and class-work	115	115	90	After violent class dancing the second blood-pressure was 150.
15	G. L. ...	21	,,	Clubs and balls	120	122	115	Another blood-pressure was taken after brisk exercise and measured 120.

Girls of the Sargent Normal School of Physical Education—(continued).

No.	Name	Age	Occupation	Form of exercise	Blood-pressure before exercise	Immediately after exercise	After rest from three to twenty minutes	Remarks
16	M. B. ...	19	Student	Running up four flights of stairs and back	102	130	100	
17	D. Y. ...	22	,,	Running up four flights of stairs and back	115	140	After five min. rest 100	
18	E. A. ...	27	,,	Running up four flights of stairs and back	112	134	115	
19	M. P. ...	21	,,	Running up four flights of stairs and back twice	90	130	90	
20	F. C. ...	20	,,	Running two laps	114	130	100	
21	K. ...	21	,,	Running three laps	138	158	130	
22	M. ...	21	,,	Running four or five laps	120	160	100	
23	C. ...	21	,,	Running two laps	108	122	90	
24	D. ...	20	,,	Running two laps	130	170	130	
25	H. ...	20	,,	Running two laps	118	130	115	
26	W. ...	20	,,	Running two laps	115	118	110	
27	N. ...	22	,,	Running three laps	110	160	115	
28	C. ...	20	,,	Running three laps	112	152	118	
29	E. ...	21	,,	Running four laps	117	158	112	
30	S. ...	19	,,	Running three laps	115	140	118	
31	F. ...	20	,,	Running three laps	120	152	115	
32	B. ...	19	,,	Running three laps	117	140	116	
	G. ...	27	,,	Played piano for one hour for class	124	120	120	

Gymnasium Members—Men.

No.	Name	Age	Occupation	Form of exercise	Blood-pressure before exercise	Immediately after	After rest from three to twenty minutes	Remarks
33	B. ..	30	Gymnasium instructor	Class-work	128	140	135	Taken at another time it was 120, 120, 135.
34	T. ...	21	Waiter	,,	123	120	120	This man works all night, and then comes to the gymnasium.
35	R. ...	31	Dentist	,,	120	130	116	
36	W. ...	39	Business	,,	115	160	117	
37	D. ...	49	Real estate	,,	130	140	132	
38	B. ..	39	Metal polisher	,,	142	142	115	He had probably been doing some work before the first measurement was taken.
39	McA. ...	45	Journalist	,,	139	130	125	He had probably been doing some work before the first measurement was taken. Taken again, the first measurement was 130.
40	J. ...	37	Baggage master	,,	115	120	115	
41	P. ..	53	Shoemaker	,,	130	160	130	
42	Mc. ...	21	Student	,,	114	118	110	
43	R. ...	62	Dentist	Class-work and running	140	180	140	
44	W. ...	28	Post Office clerk	Run a mile	130	185	130	
45	S. ...	57	Locomotive engineer	Class fifteen minutes	140	140	140	Taken another time, 145, 145, 120.
46	R. ...	27	Physical Director	Dancing	130	150	120	
47	C. ...	28	Clerk	Class	140	160	130	Worked all the previous night.
48	F. ...	22	Waiter	,,	130	150	117	
49	W. A. S.	36	Police inspector	Hand-ball	120	130	115	Smokes immoderately.
50	C. ...	26	Gymnasium instructor	Class and dancing	125	138	118	
51	L. ...	31	Chauffeur	Class-work	138	158	125	
52	S. ...	19	Stamper	,,	115	150	112	
53	C. ...	30	Post Office clerk	Class-work and a hard ¼ mile run	130	180	114	The third measurement was taken ¼ hour after bath.
54	D. ...	18	Clerk	Class-work	138	180	130	

Gymnasium Members—Men (continued).

No.	Name	Age	Occupation	Form of exercise	Blood-pressure before exercise	Immediately after	After rest from three to twenty minutes	Remarks
55	R. ...	36	Gymnasium instructor	Running four laps	120	140	114	
56	V. ...	19	Gymnasium helper	Running three laps	110	154	120	
57	S. ...	37	Sale-man	...	150	140	138	
58	M. ...	30	Police officer	½ hour hand-ball	115	100	90	
59	G. ...	33	,,	,,	128	120	120	
60	R. ...	33	Jeweller	...	100	115	100	
61	R. ...	26	Salesman	...	148	168	134	The last measurement seven min. after exercise.
62	K. ...	27	Clerk	...	110	118	116	
63	H. ...	40	Gymnasium instructor	Dancing and heavy dumb-bells	125	140	120	Taken again, 118, 140, 122.
64	B. ...	29	Student	Class-work	120	132	118	
65	K. ...	21	At service	,,	100	115	116	
66	B. ...	35	Salesman	,,	117	155	125	
67	C. ...	41	Masseur	Giving massage briskly	145	170	150	Had been doing some work before first measurement.
68	L. ...	49	Business	Class-work	130	170	120	
69	C. ...	26	Clerk	,,	145	140	140	Probably had been doing some work before first measurement.
70	M. ...	29	Electrical engineer	,,	100	115	100	
71	E. ...	30	Lawyer	,,	130	130	120	Well trained. Exercises three, four or more times a week.
72	S. ...	33	Stationary engineer	Chest weights and dumb-bells	120	120	117	Night work.
73	L. ...	21	Waiter	...	140	138	138	First measurement after some exercise.
74	B. ...	20	Attendant	...	130	115	115	First measurement after some exercise.
75	S. ...	20	Stenographer	Class-work	130	140	130	Takes a good deal of exercise.
76	S. ...	29	Journalist	,,	120	134	130	
77	L. ...	24	Clerk	Was given brisk massage	115	115	117	No exercise, but massage.
78	S. ...	25	,,	Class-work	120	140	120	
79	S. ...	30	Book-keeper	,,	130	150	120	

Gymnasium Members—Men (continued).

No.	Name	Age	Occupation	Form of exercise	Blood-pressure before exercise	Immediately after	After rest from three to twenty minutes	Remarks
80	M. ...	25	Electrical Engineer	Brisk, severe, short exercise	115	140	117	
81	R. ...	26	Clerk	Class work	120	150	120	
82	G. ...	17	Apprentice	,,	130	130	115	Had taken some exercise before first measurement.
83	L. ...	25	Draughtsman	Chest weights and mat work	117	130	115	
84	L. ...	28	Police officer	Hand ball	115	118	100	
85	McG. ...	36	,,	,,	140	150	125-138	Had taken a walk before the first measurement.
86	D. ...	36	,,	,,	135	130	120	Uses alcohol and tobacco to excess.
87	P. ...	39	Railway post office clerk	Hand-ball and dancing	100	115	115	
88	C. ...	19	Student	..	115	112	115	
89	C. ...	40	Lawyer	...	130	150	132	
90	R. ...	59	Clerical	Rowing	130	140	125	
				Boys.				
91	D. ...	15	Apprentice	Class-work	100	108	100	
92	E. O. ...	11	School	,,	114	124	110	
93	J. O. ...	13	,,	,,	112	115	95	
94	M. ...	14	,,	,,	125	118	95	Had been wrestling before the first measurement.
95	H. ...	11	,,	,,	98	110	98	
96	S. ...	13	,,	,,	117	110	100	

Gymnasium Members—Men (continued).

No.	Name	Age	Occupation	Form of exercise	Blood-pressure before exercise	Blood-pressure immediately after	Remarks
97	S. ...	20	Clerk	Class-work	112	126	
98	K. ...	36	Salesman	,,	110	118	
99	C. ...	28	Clerk	,,	122	150	
100	T. ..	62	Merchant	,,	138	118	This man looked over-worked and tired out.
101	D. ...	49	...	...	120	140	
102	J. ...	39	Musician	...	145	150	
103	S. ...	19	...	Class-work	100	115	
104	D. ...	34	Attorney	,,	120	130	
105	L. ...	31	Banker	Pull-ups and dips	160	180	Exercise had been taken before both of these blood-pressures.
106	M. ...	38	Salesman	Class-work	120	128	
107	M. ...	30	Attorney	,,	125	115	Says he is overworked in mind and body.
108	P. ...	37	Weigher	,,	116	116	Says he took slight exercise before first blood-pressure.
109	S. ...	37	Salesman	,,	132	140	
110	W. ...	39	Hotel-keeper	...	115	112	Wt. 190. Not used to much exercise.
111	R. ...	49	Merchant	...	140	148	
112	S. ...	46	Physical Director	...	130	142	
113	R. ...	50	Merchant	...	130	160	
114	H. ...	39	Police Officer	...	120	150	
115	S. ...	43	Merchant	...	130	160	120.
116	L. ...	22	..	Class-work	108	140	
117	W. ...	23	...	Chest weights	120	115	
118	B. ...	20	...	Class-work and running	122	160	
119	B. ...	18	...	Class-work	138	158	

Gymnasium Members—Men (continued).

No.	Name	Age	Occupation	Form of exercise	Blood-pressure before exercise	Blood-pressure immediately after	Remarks
120	C. ...	28	...	Class-work, slight	112	120	
121	D. ...	18	...	Class-work, slight	140	142	Played ball before first blood-pressure.
122	M. ...	24	...	Class-work, slight	150	184	
123	P. ...	22	...	Class-work,	140	170	
124	F. ...	30	...	,,	94	120	
125	A. ...	19	...	Class-work and running	140	190	
126	H. ...	61	...	Running two to three laps	158	192	

DISCUSSION.

Dr. J. A. MILLER: I would just like to ask Dr. Otis if he observed the pulse-rate in these experiments. For a number of years I have used the blood-pressure, as has been suggested by Crandall, as a guide to exercise in tuberculosis, but taken in conjunction with the pulse-rate.

Dr. E. O. OTIS: In reply to Dr. Miller I would say that in similar investigations the pulse-rate has been taken in connection with blood-pressure, but in my investigations I wanted to see what inferences I could draw from the blood-pressure alone, and I present my results for what they are worth. It seems to me that they suggest a useful practical guide in taking physical exercise as I have stated, and I trust that some one may repeat them in connection with the pulse-rate.

THE TREATMENT OF THE PORTAL OF ENTRY OF SYSTEMIC DISEASES.

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In discussing the question of the treatment of acute articular rheumatism, with its associated diseases, such as endocarditis, chorea, and tonsilitis, it is well to review briefly the question of the etiology of rheumatic fever.

For many years the metabolic theory of its causation held sway, but as Newsholme has shown, the epidemic character and seasonal variations, as well as the evidences of its inflammatory character, have caused all to recognize the disease as one of the acute infections, and there are to-day four theories as to its bacterial etiology, namely: First, there is no definite micro-organism connected with the disease, which is a form of septicæmia due to attenuated staphylococci or streptococci (Cole). Second, the specific organism is a diplococcus (Poynton and Paine). Third, the disease is undoubtedly an infection, though the organism is not known. Fourth, the disease is due to a specific bacillus (Achalme).

At the end of a brief paper by Wooley, reviewing the question of etiology, he says, "If the disease is an infection, then where is the portal of infection?" "The relative frequency of a coincident or previous sore throat or tonsilitis points to the importance of the great pharyngeal filter as a portal of entry. But if one adheres to the theory that the

disease is the expression of a pyæmia, as the writer does, he will necessarily feel that the portal of entry may be at any point where a suppuration exists." If one reviews the literature of these allied diseases, the points mentioned above are impressed upon one strongly. In 1888, in the Statistics of the Collective Investigation Committee of the British Medical Association, Cheadle points out that of the 655 cases of acute articular rheumatism, 178 gave a history of sore throat; in other words, almost 28 per cent. had sore throat preceding or during the attack of acute articular rheumatism.

In one of the best reviews of the literature of tonsilitis as a preceding symptom to other diseases, George B. Wood showed that it was present, according to many authors, not only in acute articular rheumatism, but also in cases of septicæmia, pyæmia, acute nephritis, endocarditis, bronchopneumonia, pleurisy, appendicitis, &c., &c. His bibliography covers 118 articles, and in my brief review of the literature I have covered many more not mentioned by him. One case that I had some years ago called my attention to this condition. It was that of a nurse in a children's hospital in which there had been an epidemic of tonsilitis. The nurse contracted tonsilitis and pharyngitis, apparently of a mild grade, and five days later developed an acute streptococcic peritonitis for which she was operated upon, and at the operation there was absolutely no evidence of a primary focus in the abdominal cavity, the appendix, tubes and ovaries, stomach and gall-bladder being examined carefully. The character of the articles quoted by Wood, to say nothing of the evidence through their number, certainly is more than suggestive that the tonsils are frequently portals of entry for other diseases.

That other areas of suppuration might play a part in

accounting for portals of entry, other than the tonsils, is shown by the frequency with which chronic suppuration of the frontal and ethmoidal sinuses, antrum of Highmore, and chronic otitis media are mentioned as coincident conditions to recurring arthritis.

There is one portal of entry, however, that has not received the attention due to it, although the author of the paper first calling attention to the local disease had the disease called after his own name, and in that paper, published thirty-five years ago, stated that he believed and knew that many systemic conditions were due to suppurative pyorrhœa.

This paper, by Dr. John W. Riggs, dentist, of Hartford, Conn., was read before the American Academy of Dental Surgeons in New York, on October 20, 1875, and although the dental profession recognized the importance of this paper from the standpoint of dentistry, yet they refused to believe that the condition of the gums and teeth was not due to systemic conditions present, although Riggs clearly pointed out that the systemic condition was due to the teeth and not the teeth to the systemic condition. His paper is so excellent and so appropriate to our views to-day that I will quote at some length from it. In his introductory remarks he tells of one patient who "besides great prostration from aggravated symptoms became nearly blind. She could not see to read ordinary print, and could only tell the number of windows in a room by the mass of light from each. She could not walk up a flight of steps without assistance." He further says, "I had the pleasure some three years ago of presenting this patient for examination before that very enthusiastic society of workers, the Brooklyn Dental Association. She was then well, sufficiently so to walk several miles daily. Gums and mouth healthy,

appetite good and fast improving in general condition." He then divides pyorrhœa into four stages, according to the inflammatory condition of the gums, the recession of the gums from the teeth, and the absorption of the alveolar process, and the loosening of the teeth. He denies the pathology of the condition accepted at that time, namely: That the patients had "scurvy of the gums," bone disease, old age, an inherited or a "scrofulous" diathesis, and gives as his view of the pathology, that the disease is caused by the formation of tartar on the teeth below their junction with the gums, thus separating the gum from the tooth, and thus allowing particles of food to be held within these clefts, which undergo decomposition and set up suppuration, and as a proof that his view is correct, he showed that, in the early stages, by scraping away the tartar the gums would become pale, lose their tenderness, and adhere closely to the tooth, while in the advanced cases if you pull the teeth the gums rapidly heal, and assume their normal pink colour.

That the portal of entry might be due to other suppurative conditions about the teeth than pyorrhœa can be shown by the isolated articles in the dental literature, but there is one paper, lately published, which is most convincing, in which Dr. Clarence J. Grieves, dentist, reports fourteen cases of systemic disease, chiefly arthritis, referred to him by Dr. William S. Baer, and his assistants, in which X-ray pictures showed blind abscesses at the base of one or more teeth, and that following the extraction of the tooth, or the drainage of the abscess, there had been immediate disappearance of the arthritic symptoms, although they had not been relieved previously by medicinal treatment. His article contains reproductions of his X-ray plates, and although they do not show up as clearly in the reproductions as they do in the original, yet they are quite con-

vincing. In his conclusions he points out the fact that these blind abscesses can exist without any local symptoms, such as pain, although in many cases where there is no pain noticed by the patient he has been led to suspect that there was an abscess at the root of the tooth from the fact that there had been some tenderness on firm pressure over that portion of the alveolar process. He also calls attention to the fact that these abscesses will occur with the most careful and best dentistry, and that an ordinary examination of the mouth and teeth will show nothing, apparently, abnormal. In most of his cases the abscesses had occurred in teeth which had been crowned.

The three articles cited above by Wood, Riggs, and Grieves are decidedly the most important articles on the question of portal of entry of systemic diseases, such as rheumatism and endocarditis, while the articles of Dana, Poynton and Paine, and Spear (quoted by Rosenheim) point to the fact that chorea is to-day more generally looked upon as an acute infection, and probably belongs, from clinical evidence, to the group in which acute articular rheumatism occupies an important place.

In a pretty careful review of the text-books and systems published in English during the past five years on "Practice of Medicine" and "Therapeutics," there is, practically, no mention of the need of treating the portal of entry during the quiescent periods or during the active periods of these diseases, save in one system on treatment lately published, which dismisses the subject with a short paragraph, and leaves one with the impression that we too frequently remove the tonsils without cause.

My interest in this subject dates back to three years ago, when during a service in the University of Maryland Hospital I had fourteen cases of arthritis, thirteen of which were

typically of the acute articular rheumatic type, while the remaining one was a multiple purulent arthritis following an abscess in the back. In two of these cases, which were subacute in character, but in which many joints were affected and the temperature was only moderately elevated, I failed to get a cure under the usual rest treatment, with the addition, of course, of the salicylates combined with alkalines, and as in these two cases the tonsils appeared normal on careful examination, and as the tonsillar glands were neither palpable nor tender, I searched for other portals of entry. It was noted that with these two patients the breath was at all times a little foul, and that there was present a well-marked pyorrhœa, and that on pressure purulent matter would escape at the junction of the gum and tooth. I had a dentist treat the condition noted above, and immediately the temperature became normal, the joint symptoms disappeared, and the recovery was rapid and uneventful. I was so much impressed by those two cases that ever since that time, when I have been "on service" at the hospital, I have requested that a dentist shall look after the teeth of all patients suffering with rheumatism or valvular disease of the heart, whether acute or chronic.

Before reporting my cases, which are selected ones, I desire to quote from an unpublished paper of Dr. Irving J. Spear, of Baltimore, read on June 9 of this year. In discussing the treatment of chorea, he says, under the sub-title of "Removal of the Cause": "Careful examination of the nose and throat should be made, and, if found diseased, should be properly treated and surgical treatment instituted if necessary. In twenty-one cases in which the throat was carefully examined it was found that twelve had diseased tonsils, and tonsillectomy was advised in all these cases, and seven had their tonsils removed. One of these cases, which

was very severe, had existed with some slight remissions for ten years, but after tonsillectomy this case showed marked improvement, and is now practically well. One had three previous attacks and the last attack had existed for a long time, but was completely cured within a short period after operation. Another case that had had four previous attacks and had continued in the present attack for several months, with severe choreic movements, was completely cured. The other cases, which were less severe, promptly recovered."

"It has been my experience that in the cases which have diseased tonsils it is advisable to treat the patient with anti-rheumatic remedies, and antiseptic throat and nose washes, until the acuteness of the local condition is relieved, and then institute the necessary surgical procedure, it not being necessary to wait for the cessation of the choreic movements. In my earlier cases I treated the patients medicinally until the choreic movements ceased, and then had the tonsils and adenoids removed; but in the later cases, as soon as the condition of the throat justified, the tonsils and adenoids were removed. In the latter cases the average duration of treatment was about twenty days, while in the former cases it was more than twice that period."

Dr. F. D. Sanger has also informed me lately of two cases of chorea where he had been called upon to do a tonsillectomy, and in both these cases there had been a cessation of choreic movements forty-eight hours after operation, and that they had remained well now a matter of some weeks.

The cases which I desire to report are as follows:—

Case 1. Mrs. B., aged 43, had had one or more attacks of mild but typical acute articular rheumatism, practically every winter since she was 18 years of age, and prior to most of the attacks there had been a sore throat, and at

times attacks of quinsy requiring operative measures. Although not the physician to this patient, but simply a friend, I had seen her during the attacks and when she was free from them, and her throat condition at all times showed hypertrophy of both tonsils, with a general congestion of the pharyngeal ring. After much urging she consented to having her tonsils removed, and for the three winters following the removal of her tonsils she was not only free from tonsilitis and rheumatism, but noticed a marked difference in her general condition and her ability to take comparatively long walks. This winter she had another attack of rheumatic fever, the joints of the wrists, fingers, and ankles being involved, and her family physician referred her to Dr. Wm. S. Baer for special treatment. Dr. Baer very kindly told me of his findings, which were that, in addition to the joint involvement mentioned above, he found that there was no evidence of inflammation in the throat, as the previous operation had been absolutely successful. Although the teeth appeared to be in an absolutely perfect condition, as Mrs. B. had just had the dentist examine her teeth a month previously, and as she suffered no pain, yet, on pressure exerted along the border of the gums well above their free border, it was noticed that there was an area of tenderness over two apparently strong and healthy teeth. An X-ray picture was then taken of these teeth, and there was found the distinct shadow, at the base of each, characteristic of pus formation, and on withdrawal of these teeth pus cavities were found. After the removal of the teeth there was a rapid and uneventful recovery from the arthritis.

Case 2. This case was of interest not only from the rapid recovery after the treatment of the portal of entry, but also on account of the fact that the patient was practically a walking pathological museum.

N. A. C., male, aged 42, widower, a carpet weaver by trade. This patient was admitted to my service at the University of Maryland Hospital on November 16, 1910, complaining of "rolling feeling of heart," indefinite pains in back, stomach and limbs, and especially of mental depression and a desire of being left alone. The family history is unimportant, and there is no family tendency noted of a neurotic or neurasthenic taint. According to his history, he had measles when 28 years of age, and a slight attack of pain (pleurisy) six or seven years ago. There was no history of scarlet fever, diphtheria, typhoid, pneumonia, rheumatism, or hæmoptysis, and he denied ever having had venereal disease. Patient had definite tertian malaria in 1881. Patient said that during the past six months he had noticed a sensation of twitchings in different parts of his body, and that for the past three months had been feeling distinctly "badly" and rather melancholy, preferring to be alone at all times. He came to the hospital on account of this depression and on account of the feeling that he had at times that his heart was "turning over," and that it "almost stops beating." Appetite is good and bowels regular, and he had no digestive symptoms, save that infrequently there is a fullness after eating, and the "rolling" of the heart is more noticeable then. Patient had no cough, no shortness of breath, no pains in chest, no chills, flushes or sweats, nor were there any vocal symptoms. No symptoms of the circulatory system, save for the heart condition described above, which is at times accompanied by a gurgling sound in heart area. The urinary symptoms were chiefly polyuria, more marked when depressed, and a tendency to dribble urine after retention longer than usual. At times had increased frequency, but had never noticed pain on urination or œdema of the ankles. Patient slept fairly well, but was inclined to be irritable, and lately had

noticed that he gets angry on slight provocation and was easily excited. He had lost about 20 lb. in the past six months. The examination of the urine showed that between 40 and 50 oz. were passed in the twenty-four hours. A "twenty-four hour" specimen showed a specific gravity of 1018, acid in reaction, with no albumen or sugar, though there was a slight trace of indican and an occasional hyaline cast in the centrifugalized specimen. Blood examination showed leucocyte count 8,200, and hæmoglobin 100 per cent. The physical examination note on his history is as follows: "Patient is a well-developed white man, and at the time of examination in dorsal decubitus position. Fairly well nourished. Head covered with a good crop of hair. Ears and nose apparently normal, and no evidence of tophi. *Eye examination* shows moderate ptosis of right lid. Right cornea hazy on lower half, but left normal. Eye motions normal. Right iris adherent below and to nasal side, pupil 1 mm. in diameter, and active. Left iris normal, but pupil 2 mm. in diameter. Both react to light and accommodation. *Mouth:* Tongue protrudes in median line, and has a whitish coating, but no tremor. Teeth in extremely bad condition, gums having receded from front teeth so much that they resemble a picked fence, and many of them are absent. Pyorrhœa marked and breath foul. Pharynx and tonsils apparently normal, and no palpable glands noted in neck. No tracheal tug made out. *Chest:* Somewhat barrel-shaped, with very slight movement on respiration, although apparently equal on the two sides. Examination of lungs shows nothing abnormal, save for a moderate degree of general emphysema. *Heart:* Apex visible and palpable in fifth interspace, 5 in. from mid-sternal line. No other pulsation noted above chest walls. Palpation of heart negative. Percussion shows that absolute cardiac dullness extends $5\frac{1}{8}$ in. to left of mid-sternal

line in fifth interspace, and 4 in. in fourth interspace, and is limited above by the third rib. No cardiac dullness noted to right of sternum. Sounds are best heard at apex, and the first sound is loud and forcible, the first part of which is accompanied by a loud blowing murmur, which can be traced upwards over heart and outward to axilla. Second sound is clear. At base both sounds are clear, though somewhat distant, and second pulmonic is louder than the second aortic sound. Blood-pressure in both arms is the same, and with broad cuff is 132 mm. Abdominal examination discloses nothing abnormal, and examination of extremities and of reflexes negative. On account of the inequality of the pupils an X-ray picture was taken, which showed a shadow the size of a fifty-cent piece to left of sternum at level of second rib (aneurism ?). X-ray plate also showed concentric enlargement of the heart. Unfortunately no fluoroscopic examination was made.

For the first five days following admission patient was kept in bed and temperature taken every three hours, and no medicinal treatment instituted, save a tonic (nux vomica) given before meals, and the patient kept on a soft diet. From this fifth day on the patient was made to clean his teeth morning and night, and was required to rinse his mouth thoroughly before and after each meal or nourishment, with a solution composed of equal parts of grain alcohol, water and peroxide of hydrogen. Prior to the use of the mouth wash the patient's temperature rose to 100° or 100.5° F., but as soon as the treatment of the teeth was instituted the temperature never went higher than normal, and there was a most marked improvement in the general condition of the patient, and especially marked by the disappearance of his psychasthenic symptoms, and this improvement continued after his discharge from the hospital and his after-treatment in the out-patient department. The

interesting point in his case is the fever which did not subside on rest, but subsided immediately on treatment of the pyorrhœa.

The next case is of interest especially on account of the fact that the boy had had chorea as a young child, and on his first admission to the hospital had a well-marked mitral valve lesion, with evidence of absorption from the pharyngeal ring, as shown by the palpable glands at angle of jaw.

Case 3. C. S., aged 19, inmate of Maryland School for Boys. Medical numbers 5,179, 5,186, and 5,383. This patient was admitted to the University of Maryland Hospital on May 24, 1910, complaining of indigestion and rheumatism. His family history was unimportant, father and mother having died when patient was a baby. His adopted mother had heart disease and rheumatism, but her two children (boys) had no symptoms of either disease. According to patient's history, he had never had typhoid, pneumonia, scarlet fever, or diphtheria, but had measles and whooping cough as a young boy, and at the age of 5 chorea. He also said that he had inflammatory rheumatism. There is no note in the history as to whether he had ever had tonsilitis or not. Prior to his admission to the hospital he had been suffering for some little time with attacks of most marked distension after meals, which were relieved by the escape of gas or by vomiting. He had also some pain in the region of the heart, and the bowels at times were somewhat loose. Appetite was fair, but frequently severe indigestion characterized by a fullness and weight coming on quite a long time after eating. While in the hospital patient had an attack of acute indigestion with intense abdominal distension, and belching of large quantities of gas, the abdomen being markedly distended and tympanitic. The stomach tube was passed and a large quantity of poorly-chewed meat and undigested food withdrawn, and patient

also vomited a large amount. After the lavage there was an immediate relief of the symptoms. Patient's temperature on admission was 99.2° F., pulse 80, and respiration 20, and during his stay of twenty-six days temperature did not go above 98.8° F., and pulse ranged from 70 to 90. Urinary examination was negative, and the blood examination showed a "leucocyte count" of 7,400 and hæmoglobin of 80 per cent. The physical examination on admission was as follows: "Patient is a white boy in dorsal decubitus position, showing no evidence of pain. There is a tendency, however, to slight incoördinate movements, especially on excitement. Has been very 'nervous' since he had chorea at the age of 5. Scar over right forehead. *Eyes:* Pupils equal and moderately dilated, and react to light and accommodation. Ocular motions good. Conjunctiva of fair colour, and sclera of a slight bluish tinge. No tenderness over frontal sinus, but there is noted a slight tenderness over antrum on left side. *Ears:* Show no discharge or tophi, and no tenderness now over mastoid, although patient said there was some tenderness there prior to admission to the hospital. Nose negative. Tongue protrudes in median line and has whitish coating on dorsum, but no tremor. Teeth are in fair state of preservation, somewhat stained, and an occasional decayed spot noted. Pharynx: in good condition and no hypertropy of tonsils, but *glands of neck at angle of jaw are palpable.* Chest: expansion good and equal on the two sides. There is some bulging of left chest in cardiac region anteriorly. Lungs negative on percussion and auscultation, save for a slight intensification of voice sounds and prolongation of expiration at right apex. Heart: point of maximum intensity visible as a rather diffuse impulse in fifth and sixth interspaces. Absolute cardiac dullness begins at the third interspace above and extends in fifth interspace to a little outside the mid-clavicular line. At

apex the first sound is replaced by a loud rasping systolic murmur, followed after a pause by two beats of the heart, in rapid succession, the first sound of each beat being replaced by a systolic murmur. Occasionally the second sound is not heard, when there is noticed a loud blow followed by two quick blows for every three beats of the heart, and "pulsus bigeminus" is noted at that time. The systolic murmur is transmitted to the axilla, but is also heard all over the præcordium. Over the pulmonic region the second sound is markedly accentuated. Abdominal examina- is negative. Examination of the extremities shows the right knee to be somewhat stiff, swollen, reddish in colour, and warmer than other parts, and distinctly painful on motion. Same condition to a lesser degree noted in left ankle and left knee. Upper extremities negative. During the patient's stay in the hospital the joint symptoms disappeared, and the note on "discharge" stated that there was no evidence of rheumatism at that time, and that the heart sounds were normal, save for the replacement of the first sound by a loud systolic murmur with accentuation of the second pulmonic. Patient was re-admitted eight days after he had left the hospital on account of "pain in the abdomen and over region of heart, with slight headache." The note on the physical examination at this time is exactly similar to the one made at his previous admission, save that all joints were, apparently, normal, and that on this examination abdomen was markedly distended. His temperature, pulse and respiration remained normal during the ten days he stayed in the hospital the second time, although he had one attack of acute gastric distension which required lavage to relieve him. Patient was re-admitted to the hospital November 5, 1910, four months after previous discharge from hospital. His temperature on admission at this time was 101.8° F., pulse 90, respiration 22. Patient was more or

less delirious and no history was obtained from him, save that he had sore throat and headache. On account of delirium he would not stay in bed and required a restraining sheet. Bowels and bladder acted involuntarily, and patient had diarrhœa. Physical examination was difficult on account of patient's irritability, but examination showed nothing different from that made on last admission, save that there was a most marked congestion of pharynx and tonsils. A leucocyte count made thirty-six hours after admission showed a leucocytosis of 30,600. Seventy-two hours after admission delirium became more marked and it was noted that the right pupil was larger than the left, though both reacted to light. There had been some vomiting during the morning and stiffness of the neck with some apparent weakness in the right arm, as patient did not use it as much as the left. At that time the patella and tendo-Achillis reflexes were increased, although there were no Kernig or Babinski signs present. Lumbar puncture was done, and an ounce of turbid fluid was withdrawn under some pressure. Smears made from fluid showed many polymorphonuclear leucocytes, but no organisms, and cultures on agar-bouillon were negative. Patient died twelve hours later. During the three and a half days that the patient was in the hospital his temperature ranged from 101 to 102.4° F., and pulse varied from 90 on admission to 110 prior to the rapid increase when patient was dying. The autopsy on this case showed an acute endocarditis with hypertrophy and dilatation of heart, due to mitral insufficiency. Acute splenic tumour was also noted, and multiple infarcts in both kidneys. Cultures were not obtained.

My reason for including this case is that with this patient we had a history obtained during the first two stays in the hospital, which showed that he had chorea, valvular disease of the heart, and lately an inflammatory rheumatism,

and although the tonsils were not hypertrophied, yet the fact that the tonsillar glands were palpable ought to have directed our attention to the fact that his tonsils were diseased and had been, probably, the portal of entry for his previous infections, and I myself believe that if his tonsils had been removed when he was first in the hospital that he would have escaped the final endocarditis and septicæmia which caused his death, and which was ushered in by a sore throat.

Case 4. This patient was referred to me by Dr. Hiram Woods, with the request that I study her with a view to finding the fundamental or remote cause of her eye condition. In a note on the case lately sent to me by Dr. Woods he says: "Mrs. J. D. T., 29 years of age, was first seen November 15, 1910. She had lost the sight of her left eye suddenly, three days before. The right eye was normal. The cause of the left blindness was a large vitreous hæmorrhage hiding the fundus, save in the lower and inner quadrant. In the corresponding upper and outer field she counted fingers doubtfully at 6 in. Under rest in bed, diaphoresis, &c., the vitreous hæmorrhage gradually cleared and a view of the fundus was obtainable, fairly well, after ten days. Large sub-hyaloid hæmorrhages were then found, one trespassing on the lower and inner border of the optic papilla, to about one-quarter of its diameter, the other covering the fovea and extending medially to the disc, which it covered to a slight degree. Efforts were made to find a systemic cause and careful physical examination, urinalyses, tuberculin tests, &c., showed nothing. Blood-pressure was 125 mm. In December and again in February there were recurrent hæmorrhages of the sub-hyaloid variety. These, as the former ones, were slowly absorbed. In February, Dr. Wilson suggested the possibility of a pyorrhœa being the portal of entry which, for some unknown

reason, might be producing a toxæmia or a metastatic condition, which in turn was affecting small peripheral vessels as in the eye. Whether his theory of the causation was correct or not the fact remains that when this pyorrhœa was corrected, there were no more hæmorrhages, and vision became normal about the middle of April, and has remained so to the present writing (June 9). In estimating the curative effect of the removal of an oral infection-portal, it must be borne in mind that these recurrent sub-hyaloid and vitreous extravasations are prone to recur, as in this case, and then suddenly cease, maybe for a long time." Dr. Woods' complete record of this case will be found in the *Transactions of the Ophthalmological Section of the American Medical Association* (1911). This patient was studied most carefully and with absolutely negative results, and the only thing noted, either in her history or her physical examination, together with the laboratory findings, that was in any way abnormal, save her eye condition, was the condition of her teeth. There was no tenderness along the gums and no decayed roots noted. The right upper canine and first two molars had been crowned, and were, apparently, in good condition. There was, however, noted a moderate degree of pyorrhœa present, and three or four teeth presented cavities at an unusual location, namely, at level of gums on their outer surfaces. The dental treatment that she received was the clearing out of these cavities and their drainage with soft temporary fillings of absorbent material, and the cleansing out of the pyorrhœa. I examined the mouth of Mrs. T. on June 9, and found that she was then free from pyorrhœa, and that there was no tenderness to be noted anywhere about the teeth. This case was included in the series for the reason that for many years these

hæmorrhages, and especially the cases of iritis, have been considered by ophthalmologists to be frequently due to the "rheumatic diathesis."

These cases here reported are entirely too few, and far from being convincing, but I have presented them to you simply to call attention to the possibility of good that might result from the searching for, and treating, a focus of suppuration that might be a fundamental cause of such diseases as acute articular rheumatism, endocarditis, chorea, and the rheumatic diseases of the eye. We all agree to-day that the first need in the treatment of gonorrhœal rheumatism is to cure the urethritis or prostatitis, and I believe that we could certainly do no harm to our patients suffering with any of the above diseases if we cleansed, with mild antiseptics, these portals of entry during the acute stages of the disease, and removed such portals during the quiescent period.

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THE DUST MENACE AND MUNICIPAL DISEASES.

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Of the causes of what may not inappropriately be termed municipal diseases, mostly obvious, some subtle in their workings, however, infection, irritation, and neuro-vascular tension, play a peculiarly predominant part. To specify three concrete elements corresponding to and mainly responsible for these etiologic processes, there are *dust, smoke*, and *unnecessary noise;* and the one that looms largest in municipal morbidity and mortality is undoubtedly the widespread prevalence of an irritating as well as infecting dust contamination of our city atmosphere. This dust menace and nuisance is preventable, not only in the streets, as is now demonstrated in a few large cities, but likewise in our living and working places, in houses, cars, stores, factories, shops, offices, stations, theatres, and churches: in fact, there is a vicious circle here, in that street dust is blown, swept and tracked into habitations, to be swept back into the streets again. Much house-dust pollution would be avoided if the original street dust were removed or allayed. Says Dr. Geo. A. Soper, of New York: "There is something incongruous about a board of health conducting a crusade against smoke and noise and at the same time allowing the streets to be filthy with dust and dirt."

In biographical and occasional references to Benjamin

Franklin it is the usual thing to have pointed out to us his many talents and rare common sense as well as his courageous patriotism and eminent public service. It is, however, perhaps as entertaining and interesting as it is instructive and exemplary to read in the autobiography of his study and efforts relative to dirty, dusty streets in Philadelphia and London, as far back as a century and a half ago. Here as elsewhere does he reveal the master mind in originality and acuity of perception, versatility of faculty, and prompt practicality of action. The dust evil was a seriously annoying problem to him as a citizen if not a sanitarian; to him dust was at least noisomely offensive if not infective. He writes of his proposal to Dr. Fothergill, of London—whom he commends as "a great promoter of useful projects"—that "for the more effectual cleaning and keeping clean of the streets of London and Westminster," contracts be let to have the dust swept up in dry seasons, especially before the shops and windows of the houses are open, and that the gathered heaps of refuse be carried away in close-covered carts. Could Franklin view the methods and results in London, Toronto, Berlin, and some other cities to-day, his only regrets might be that it had taken so long to inaugurate the improvement, and that so many cities still dragged along, apparently contented and unable to cope with a distressing dust-polluted atmosphere, even worse than in his own day, by reason of the aggravations of modern speedy traffic.

He concludes: "Some may think these trifling matters not worth minding or relating; but when they consider that though dust blown into the eyes of a single person, or into a single shop on a windy day, is but of small importance, yet the great number of the instances in a populous city and its frequent repetitions give it weight and consequence, perhaps they will not censure very severely those

who bestow some attention to affairs of this seemingly low nature."

Now that, for about seven years, street-dust as an element in the propagation of disease, especially in large cities, has received such marked and spreading recognition, the problem of street as well as house cleanliness is a live and urgent one. Modern civilization, being mainly materialistic and commercialistic, is responsible for the creation of a multifarious, mixed, material refuse : and street dust is such a pernicious and persistent menace to the public health because it bodies itself forth as veritable synthetic *pulverized poison* composed of various more or less palpable particles of mechanical, chemical, and bacteriologic substances, both irritating and infecting when inhaled.

As long ago as 1870 Tichborne and Tyndall showed that most of the particles of fine dust suspended in city atmosphere are composed of organic matter; and bacteriology has since shown that the invisible part of visible dust —that is, its germ content—is the dangerous element that calls for a drastic and determined movement for the suppression and removal of the menace everywhere. This applies mainly to cities.

Country-road dust is composed principally of ground-up rock, and is a comparatively clean dirt, irritating to the mucous membranes, but relatively innocuous as to pathogenic organisms. Besides, the task of dust-allaying must obviously for some time to come remain a municipal one, excepting those suburban and more populous, much-trafficked and prosperous outlying communities, where even now many miles of macadamized and Telford roads are oiled, tarred, or sprinkled with water.

Apart, however, from the modicum of mineral dust arising from the wear and tear of street pavements by horse, wagon, and railway-car traffic, municipal dust represents

the accumulation of debris of various kinds, animal and vegetable, such as dried sputum of human origin, horse and dog droppings and slobberings, dead and disintegrated insects, scattered garbage and house sweepings, loaded vehicle losses, smoke and soot—in short, mainly an organic combination which in warm, wet weather is seething with rottenness; and in dry weather is mostly blown into our houses, noses and clothing by gusty winds, or sucked up as noxious stifling clouds by motor-cars while they speed, and trolley-cars while they are both running and braking for a stop.

To the average pedestrian dust is hardly more than an annoyance; and hence the large opportunity and high duty of men in our profession to educate the public to the dangers of dust; to show that it is not simply an irritant to the eyes, nose, and throat, but a serious carrier of infection by inhalation and swallowing; that the pus-producing germs, so abundant in such dust, may and do infect and produce purulent conjunctivitis, boils and carbuncles, and the graver purulent catarrhs of the nasal, faucial, and bronchial tissues.

That most of the communicable diseases of the respiratory tract are produced and transmitted by dust is doubtless true. For years we have had before us the deadly relation of the dust evil to tuberculosis. Were that the only danger, surely the awful prevalence and mortality-rate of the "Great White Plague" would alone justify the fight for street cleanliness and a declaration of independence against dust distributers. But when one adds to this the host of other dust-borne diseases—catarrhal, tonsillar, bronchial, influenzal, pneumonic, rheumatic, cutaneous—the need for efficient public service in remedying and removing the evil becomes intensely imperative, and the demands inexorable for right results.

Epidemics of purulent catarrh, tonsillitis of severe type, influenza, bronchitis, sore eyes, and boils have frequently and commonly been associated with or have closely followed prolonged meteorologic periods of dry, gusty weather, when it was too cold to sprinkle the dirty streets properly, or the city authorities have been too careless in beginning the cleaning and sprinkling of streets early in the season.

Dust particles are necessary nuclei for the formation of fogs (as experimentally shown by Carl Barus) and the suspension of atmospheric moisture; and thus a twofold unhygienic relation of dust should be brought to mind. In the first place, an excessive amount of municipal dust, attracting to itself a corresponding amount of moisture, actually renders the sensible humidity of the city air more unbearable and debilitating generally. Secondly, conceding "that pathogenic organisms are adherent to particles of dust of various kinds, and that their retention of virulence depends upon the amount of hygroscopic moisture with which they are associated," as Harrington points out, the more they are protected by such hygroscopic dust particles, the longer they will sustain the viability to which such moisture is essential, especially in warmer temperatures.

It is a needful thing in public health teaching to dispel the notion—the obsession it has almost become—as to "catching cold." Truly, most of the so-called "colds" are dust infections gotten in places where people congregate and traffic circulates freely, as in streets, cars, theatres, department stores, moving picture shows, halls, &c. As Woods Hutchinson has aptly put it, "colds" might rather be called "fouls." Human agency is principally at fault in polluting the air with disease-bearing dust, and human agency and energy must be solicited and directed to arrest, subdue, and prevent its production and propagation. The so-called air-borne diseases of great cities are really synony-

mous with dust-borne. Instead of bad air in the vague sense, let us speak of dusty air in the definite sense; instead of the Italian malaria, the Greek derivative, *Konisaeria* (*Konis*, dust; *aer*, air).

One of the most significant discoveries of recent times in clinical medicine is the not infrequent causative relation of follicular tonsillitis to the early development of rheumatic, endocarditic and pericarditic complications and sequelæ. On first thought it may seem like a startling and incredible statement to make that dust may at times so infect the tonsils and through these portals cause the most serious and malignant involvements of joint and heart structures; and yet sufficient medical literature and the writer's careful study of several cases demonstrate clearly that the links of the pathologic process do connect.

Dust, then, is not by any means or in the main a mere nuisance and source of public discomfort, but perforce a menace and direct public danger of deadly potentiality.

Further still, as an habitually inhaled mechanical and sometimes chemical irritant alone, dust predisposes the upper air passages to later if not occasional associated bacterial implantation, because of the production of a catarrhal soil of ready receptivity and decreased local vital resistance; the germs are not only invited, but embraced and encouraged to stay, multiply and penetrate to the innermost portions of a body at the same time somewhat generally debilitated and vulnerable. Here again comes forth a vicious circle. The more dusty the air of our cities, and the more consequent cartarrhal irritation, the more sputum and the more spitting promiscuously in public; and the more people spit the more infectious and dangerous the dust becomes.

The street-cleaning problem cannot be disassociated from the problem of the enforcement of anti-spitting laws. People

with naso-pharyngeal and bronchial catarrhs must expectorate somewhere, and for many years to come they will do so on our highways. It is practically difficult and a great tedium to progress in this matter to stop much of the expectoration on our streets so long as inadequate and inefficient means and methods of street-cleaning and dust-allaying fail to control or suppress the dust evil.

As the anti-dust campaign, in Philadelphia at least, got its first impetus from the standpoint of the prevention of tuberculosis, a special reference to the relation of dust to this widespread disease may be made with propriety. First, the constant inhalation of all kinds of irritating dust makes the invasion of the tubercle bacillus easy. This is well known as regards occupational mineral and organic dust not only, but particularly municipal street and house dust of ordinarily constant prevalence. General as well as local predisposition is coupled in that the environment conduces to the former equally with the latter. Secondly, although less commonly, direct infection with the tubercle bacillus from street dust may occur from recently expectorated tuberculous sputum that has dried rapidly under a strong wind on a cloudy day; but habitual infections from house dust are, of course, the usual modes. Thirdly, mixed infections with the common dust germs of pus formation, the staphylococci and streptococci, and also the bacilli of pneumonia and influenza. It is to these that we must lay the great burden of the aggravations, complications, and fatal terminations of our tuberculous patients. A simple curable early case becomes difficult or impossible to jugulate because of a mixed dust infection, and consequent extensive and progressive caseation and cavitation. How many hopeful, more or less curable tuberculous patients have run a rapidly fatal course because of the daily inhalation of a foul street dust will never be known.

Says Jacob A. Riis: "All things come to those who wait—and fight for them." The history of the agitation against the dust menace in Philadelphia, and the results obtained there to-day, while yet far from satisfactory, show that educative repetition of the facts and remedies at hand will bring about substantial improvement, and often, sooner than expected, a quite rapid progress to still better conditions. In the year 1903 the writer, while president of the Pennsylvania Society for the Prevention of Tuberculosis, inaugurated a campaign of publicity against the dust evil, particularly as related to the dirty streets and cars. For two years more the attention of the public was called to the dangers of dust, and an endeavour made to have the proper municipal authorities adopt and practice modern means and methods of street-cleaning and dust-allaying. The Philadelphia Rapid Transit Company (which operates all the trolley-cars in the city) responded to the agitation by abolishing the foul, dusty plush cushions. The city officials were inclined to resent interference with their inertia and indifference, but the criticisms began to tell to the extent that sporadic attempts at better cleaning and sprinkling of streets were made at irregular intervals.

In January, 1909, as chairman of the legislative committee of the society, the work was taken up with renewed vigour. Attention was again called to the disease-predisposing and infecting dangers attaching to the actually filthy condition of the streets and to the stupid, ill-timed, incompetent ways of attempting to clean them—a dry, dabbling method of sweeping, in spots at that, with no preliminary thorough sprinkling or flushing of the asphalt pavement, and this done in daytime in the most frequented streets, causing clouds of dust to be raised to annoy and endanger thousands of pedestrians. Also, the heaps of sweepings, even when moist, were allowed to remain for

hours and become sun and wind dried, and usually scattered about again by air-gusts and automobiles. Public opinion began to recognize that such slipshod, lackadaisical inefficiency was due to an inexcusable irresponsibility, if not a shameless cupidity on the part of officials and contractors who could thus disregard public health.

Simultaneously, the writer issued circular letters of queries to the mayors of some 25 cities of America and Europe as to the methods and results of cleaning, dust reducing, and keeping clean the streets of their respective jurisdictions. The replies from the principal cities were tabulated, and afforded a basis for a comparative study of the situation; and the results were published in the spring months of 1910 in a series of twelve articles in a few of the newspapers of Philadelphia, mostly in the *Public Ledger*. The cities reporting were 21, including Philadelphia, and stated partly the requirements of ordinances and specifications, what was actually done and how, and with what degree of satisfaction and sanitary safety according to official opinion. To enumerate the cities alphabetically, there were Baltimore, Buffalo, Birmingham (England), Berlin (Germany), Budapest (Hungary), Cleveland, Denver, Detroit, Dublin (Ireland), Leipzig (Germany), London (England), Minneapolis, New Orleans, New York, Paris (France), St. Louis, Stuttgart (Germany), Toronto (Canada), Vienna (Austria), and Washington D.C. I was able to supplement by personal observation in some of these cities, and in Munich (Germany).

To summarize:—

(1) In a majority of the cities where results were satisfactory the principal cleaning was done at night, or completed before 6 o'clock in the morning.

(2) Thorough sprinkling before sweeping. Sprinkling also done two to four times daily in dry (non-freezing) weather to lay prevalent dust.

(3) Flushing wagons, or flushing from curb to curb with hose, are used in preference to sprinkling and machine-sweeping in the best-cleaned cities. Indeed, sprinkling is seldom necessary where the streets are thus virtually washed two or three times weekly.

(4) Hand-sweeping by blockmen in daytime always preceded by wetting with a hand sprinkler.

(5) Immediate removal of piles of dirt while wet in covered wagons.

(6) Last, but by no means least, and the method which in my judgment is destined before long to supersede all others in street cleaning, is the dustless operation of dust and dirt removal by automobile vacuum street cleaners, on the principle of vacuum house cleaning now rapidly taking the place of the old dirty, dust-raising broom and feather-duster. Recent tests of these street machines have developed the fact that in one hour as much surface can be actually cleaned as was imperfectly gone over with dusty accompaniments by horse-drawn sweepers in six hours.

It was pointed out by contrast that in Philadelphia and some other cities it was adding insult to injury to attempt to clean the streets by methods that aggravated instead of mitigated the dust evil, discomfort, and danger. Sprinkling before sweeping was specified in contract, but never carried out. Hence the criticism was urged that not only better means and methods needed to be adopted, but more systematic and adequate inspection and supervision of the work done and the methods specified, and a more efficient management generally by the city street-cleaning officials, whether the work was done by the Government or by contractors. Otherwise it was futile and farcical to expect a lessening of the menace of dust. The blame for dirty streets should not be placed entirely on the day laborer who may shirk his job. He is only following an example higher up.

The people were appealed to in these articles, and a public protest sought. If they were insistent and persistent in their demands for clean streets, the city government would be equally insistent in its demand upon the contractors. The public was reminded that streets are the ventilating flues of cities, and house ventilation depends by so much upon the purity and quality of street air; whereas dirty, dusty streets became above-ground air sewers instead of pure air channels.

It soon became evident that a dust-infected people were becoming discontented, and that a city healthful was of greater importance than a city beautiful; in fact, that civic cleanliness made for civic beauty and art. Taxpayers began to realize that they were not receiving an equity of public sanitary safety.

Education has been telling, and the street-cleaning authorities have been seeing a great light in Philadelphia. The methods have improved, the work is more efficiently done, flushing wagons have recently been introduced with effectiveness, but, of course, too few as yet, and capable of attending to only a half-dozen of the busy down-town streets. A steady, strong fan-shaped column of water is driven laterally by the pressure of a gas-engine on the rear of the tank-wagon, so that all debris is flushed into the gutters from the middle and sides of the streets; the wagons horse-drawn, passing in pairs, the stream of water from the companion wagon being directed oppositely to that from the other.

It is a hopeful sign of the awakening of the public to demands for civic cleanliness that officialdom is beginning to respond in a more forthright performance of its duty and responsibility in safeguarding the public health, and incidentally safeguarding respect for law, order, and government. To avoid an insurrection of the citizenship, there must needs be a resurrection of statesmanship.

DISCUSSION.

Dr. J. H. ELLIOTT: Conditions have materially improved in the city of Toronto by the introduction of better methods of street cleaning and laying dust, but there is room for more, though it may be along lines which are rather difficult. We use a large flushing tank run on an automobile truck, which forces the dust ahead of a stream of water against the curb. On the streets on which the railway has its tracks this is done by the street railway under contract with the city. On our macadam pavements we use oil to lay the dust and find it extremely satisfactory, two coats in the spring, followed at intervals of a month, or perhaps six weeks, are generally sufficient to keep the dust down, and our civic department finds this oil dressing less expensive and much more satisfactory than the old cleaners and watering carts. But the great difficulty is keeping the dust down in the winter months. We very frequently have weeks when the weather is extremely cold and there is no snow, yet water cannot be used; during that time we have much influenza and other dust-borne disease. This is a serious problem yet to be solved.

Dr. C. D. ALTON: During the last two years I have been quite optimistic with regard to our streets. My observation extends over a number of cities, and I have one in mind where the asphalt pavement is still sprinkled by the combined machine sprinkler and scraper, and this method is in vogue in a number of cities and is remarkably good. Of course, the oiling of the streets is the most beneficial on the side streets that are not asphalted and I find this system is increasing, the old sprinkling carts drawn by horses are changed into oiling carts. The vacuum cleaner is increasing in favour and you can in this way clean a house without the use of a duster or broom. As to the difference to the house in sprinkling and oiling the streets I would mention one place where I lived. One year the street was sprinkled in the old way by the old watering cart and on my return from the country at the end of the summer I found the house filled with dust in spite of being closed. The next year the same street was oiled, and on my return to town the first of October the house was practically clean as if it had only been left the day before. I speak of this simply as a sample of the benefit of oiling over the water sprinkling. Of course there is the great difficulty of getting our civic authorities to see the value of these things. This only comes by the constant education of our profession acting on the intelligent public through the Press and otherwise and so acting on the officials. In our city of Hartford we have made one change, the street department is now in charge of an engineer, and in this way we have got many improvements that otherwise we could not have had, and the prospects are of getting many others under the Commission government, where the head is a skilled man, is paid

a salary, and has charge of a certain department, and in this system we hope for still better results.

Dr. J. W. BRANNAN: In New York we now collect the garbage and ashes at night. At first this was a little disturbing, but we soon became accustomed to it and now do not notice it; they certainly make much less noise at night than they used to do in the daytime. This system is spreading over the city, and next year the whole city will have its ashes and garbage removed at night. There is no street cleaning at night, but I hope we will get that also.

Dr. J. MADISON TAYLOR (Philadelphia, Pa.): I would like to express my hearty appreciation of what Dr. Howard Anders has done in Philadelphia. This subject will soon be of equal importance with a number of others which are vastly more popular; is closely allied, for instance, with the smoke nuisance. I am delighted to hear such optimism expressed by him with regard to the political parties. In Philadelphia there was the greatest difficulty to arouse the people; at one large mass meeting, in discussing this matter, in which the local papers were very helpful, the remark was made by one leading philanthropist that the people of Philadelphia were profoundly indifferent; that the degree of apathy which the three or four hundred people who then met exhibited was beyond conception. However, it is chiefly a matter of education, and I hope this will be achieved in due time. Until the people are educated and they demand something, they will not get any improvement.

Dr. HOWARD S. ANDERS: I wrote this paper partly to encourage any present here to do similar work in the cities where they live in which this evil is more or less prevalent. It simply means that we can do a great deal along these lines by persistent effort and through various means of communication to the public, especially and principally through the newspaper press. With regard to the oiling of the streets I alluded to this in connection with the macadam roads of suburban communities and on side streets where there were no blocks or asphalt; on pavements of the latter materials, of course, oiling cannot be carried out. And yet, I do say this, that the automobile, while an abomination as a dust-raiser, is oiling our streets somewhat by drippings, and in this respect is helping to keep down the dust in a sort of compensatory way.

ARTIFICIAL PNEUMOTHORAX AS A TREATMENT OF PULMONARY TUBERCULOSIS.

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Artificial pneumothorax therapy consists in the repeated injections of a slowly absorbable gas into the pleural cavity to permit and maintain for an indefinite period the collapse of a diseased lung.

The investigations which form the basis of this paper were undertaken to determine the exact contributory value of this treatment, and although equally willing to deny the efficacy of the method, should our results so persuade us, we conclude on the contrary that the establishment of artificial pneumothorax is a procedure of unquestionable value in selected cases.

No feature in the therapeutics of tuberculous infection is more generally accepted than the element of rest; in other words, the immobilization of the diseased part. The promptness with which an acute tuberculous infection of the hip or knee joint responds to rest produced by the application of a plaster cast convinces one of the value of immobilization.

Nature seeks to reduce the mobility of a phthisical lung by restricting the activity of the thoracic muscles of the infected side, and the chest becomes almost stationary. The ribs approximate themselves, and the normal convexity of

the chest wall is flattened. A partial fixation of the lung thus results spontaneously from the presence of the disease. Symptomatically, the general toxæmia reduces the ambition and activity of the patient, and although at one time this hint of nature was violated by clinicians who increased the activity of phthisical patients, we have now recognized the importance of prescribing rest. Associated with the quiet breathing accompanying absolute rest in bed is evident diminished toxæmia and a bettered general condition. Contrasted to this is the apparent increased activity of a phthisical process prompted by the accelerated respiration resulting from physical exertion.

The formation of a pleuritic exudate is recognized as a further effort of the disease to combat itself. Spengler, Adams, West, and Forlanini have emphasized the importance of respecting this condition and allowing the fluid to exert its compression upon the lung, thus further immobilizing it. While removal of such fluid has not infrequently hastened death, its maintenance has reduced fever, diminished the sputum quantity, and limited the toxæmia, thus bettering the patient's condition.

Spontaneous pneumothorax due to tuberculous necrosis and rupture of the lung, though once regarded as a threatening occurrence in the course of lung tuberculosis, is now accepted as an automatic effort to check the disease. Spengler reports ten cases in which he has recognized the value of this complication, allowing the subsequent accumulation of fluid to reach the level of the rupture, the exudate, thus favouring its closure. The fluid was removed in small quantities when its accumulation became excessive. Six of Spengler's ten cases complicated with hydropneumothorax recovered completely.

Evidence is not lacking therefore that certain sequelæ associated with pulmonary tuberculosis are intended to limit

the disease by immobilizing and splinting the lung. These self-limiting processes in phthisis, as in other diseases, may not only be favoured but also artificially produced.

Clinicians seek to reduce the respiratory activity by medication and body rest.

Recognizing that the spontaneous caving in of the chest wall is an effort to restrict the movements of the lung by compressing it, Quincke, Spengler, Jordan, and Friedrich have resected large portions of many ribs to further this collapse of the thorax.

The discovery of the therapeutic value of spontaneous hydrothorax and pneumothorax led to the conception that similar conditions artificially produced might also tend to arrest the disease.

Priority as to the conception of this therapeutic idea it is difficult and unnecessary to determine; as to its application, suffice it to say that Forlanini, in Italy, and Murphy, in America, were apparently independently active. In 1882 Forlanini published a brief statement to the effect that he was then at work to develop a suitable technique for the establishment of artificial pneumothorax. In 1894 a publication indicated that he had already employed the treatment, presenting at the time a technique of administration. In 1898 J. B. Murphy, in the surgical oration at the American Medical Association, independently contributed clinical results of this treatment with details of his method. In the subsequent clinical application of artificial pneumothorax therapy, Professor Ludolph Brauer has been conspicuously contributory. Forlanini, Spengler, and Schmidt have also employed the treatment continuously. Many other clinicians have reported their comparatively limited experiences, the German and Italian publications being predominant. The work of Murphy was carried on by Dr. Lemke up to his untimely death. Since 1901 the treatment

has been comparatively inactive in America. The medical literature does not intimate that this inactivity may be regarded as an abandonment of the treatment, inasmuch as there are no references even tending to discourage its applicability.

Pathology.—It is to be regretted that we have not a greater number of *post-mortem* records to show the exact nature of the pathological changes concurrent with this treatment. The autopsy records in three cases from Brauer's clinic, reported by Graetz, disclose the following changes: Tuberculous cavities showed a marked diminution in size as compared with those outlined in the clinical findings previous to the first treatment. The formation of connective tissue in the region of these cavities showed the tendency to cicatrization with contraction. There was an unusually striking tendency to callous formation throughout the tuberculous tissue with an excessive development of connective tissue in the region of the vessels of the bronchus, indicating the healing of perivascular and peribronchial inflammatory processes. The pneumonic cavities showed furthermore distinct cicatrization of the old isolated caseous areas, and the tendency to connective tissue formation around both the large and small tuberculous cavities was apparent, indicating that the infectious process had come to a point of quiescence, though complete healing did not yet exist. Both the old and new cavities were characterized by exceptionally slight content of tubercle bacilli. Graetz writes as follows: "There is no doubt in my mind that the anatomical changes in the lung must be regarded as proof that the tuberculous disease has come to a standstill and is in the process of healing." He associates this condition with the lung compression resulting from the artificial pneumothorax, and believes that there is a certain relation between the extent of the connective tissue formation and the duration of the

compression. This extensive cicatrization of the tuberculous processes, which was marked in the lung previously subjected to compression, was not present in like degree on the untreated side.

There are, and will doubtless continue to be, a number of conflicting theories as to the probable explanation of this effect of pneumothorax on the tuberculous lung. It must be admitted, however, that the compression alone is of paramount importance. The cubical contents of the previously existing cavities are diminished, to which the concurrent diminution in the sputum quantity bears testimony. The diminished amount of retained infectious material retards the activity of the tuberculous process, the immobility of the tissue lessening furthermore the transference of infectious material from one alveolus to another. There is a tendency furthermore to localize and encapsulate the smaller cavities.

Changes in the blood and lymph circulation must also be accepted as contributory factors. Czerniki credits the effect of pneumothorax to an anæmia which results from the compression, as a result of which he argues that both the bronchial and cavity secretions are lessened. It has been suggested, furthermore, that a condition of passive hyperæmia, as therapeutically produced by Bier, may take place. There is not yet sufficient evidence that a distinct change in the pulmonary circulation occurs in the presence of pneumothorax to justify the acceptance of the circulatory theory. Animal experiments have been conflicting in this regard, and it is disputable as to whether the contracted lung contains more or less arterial or venous blood. In fact, there is experimental evidence that the pulmonary circulation adapts itself promptly to the change, and is therefore not particularly disturbed.

There are reasons for believing that changes in the lymph

circulation are responsible for the clinical and pathological changes which occur after the establishment of pneumothorax. This is demonstrated clinically by evidences of diminished toxic absorption, namely, a fall in temperature, a reduced number of night sweats, and a rise in the opsonic index [Pigger]. It would seem more consistent to ascribe this to a retarded lymph circulation than to an altered blood distribution.

Pathologically it may be argued that the atelectasis following pneumothorax, restricting the lymph circulation, further limits the spread of bacteria and favours the growth of connective tissue [Beneke]. It would seem that lung compression might favour the escape of foreign infectious material into the lymph circulation, but the experiments of Graetz are evidence to the contrary, inasmuch as he has been unable to find the presence of artificially introduced material in the neighbouring lymph nodes.

It is obvious that the chances of symptomatic relief and the probability of ultimate cure by this pneumothorax therapy are dependent largely upon one factor, namely, the extent to which existing adhesions may permit retraction and compression of the lung. The lung collapse will occur in proportion to the extent of the pneumothorax; the degree of pneumothorax will correspond to the available pleural space, which in turn is dependent upon the extent and firmness of adhesions.

The entering nitrogen gas will seek the course of least resistance, and it must be remembered that the pressure under which it is introduced is not intended to be great enough to force apart any but light adhesions. Not infrequently an encapsulated pneumothorax is established, occupying an area of not more than 8 in. in diameter. Since firm adhesions border this area the pleural layers are probably not separated more than an inch, a shallow limited

space is thus established permitting but slight lung collapse with a consequent insignificant relief. If, on the contrary, a larger area is free of adhesions, the retraction of the lung is correspondingly greater and the results more gratifying. The most ideal conditions are those in which the adhesions are, though perhaps extensive, limited to the upper portion of the chest—in other words, where the disease is confined largely to the upper lobe. In such cases the introduced nitrogen not only follows the periphery, but occupies the space between the diaphragm and the lower lobe. If adhesions are not present between the latter surfaces a pneumothorax of considerable extent is established and the lung retracts to the adherent areas of the upper thorax. It is in this last group of cases that the greatest benefit in treatment may be expected.

It should be emphasized, however, that in advanced cases with apparent involvement of the entire lung it is sometimes possible to create an extensive pneumothorax. As a rule, however, the capacity of the pleural space is limited in such cases at the first injection. In cases it was surprising to find that at a second injection at the same point, a considerably greater amount of gas could be introduced under the same pressure before evidences of tension on pleural adhesions manifested themselves. The explanation of this is that the previously existing adhesions must either have become stretched or separated. It is probable that this occurs during subsequent attacks of coughing. It is a physiological fact that during forced expiration the normal negative intrathoracic pressure becomes positive. The pressure of an artificial pneumothorax is positive at inspiration and at expiration, the degree depending upon the hydrostatic pressure exerted upon the gas at the moment when its flow ceases. During subsequent coughing, at forced expiration, the pressure of this

localized pneumothorax is raised to a higher level than that pressure at which it was introduced. This explains the further separation of the pleural layers which permits the introduction of a larger quantity of gas at the second injection. It is obvious therefore that if nitrogen ceases to flow under a moderate pressure, raising this pressure to force its entrance is a dangerous procedure, for the subsequent rise in pressure concurrent upon coughing may exert an undue tension upon adhesions sufficient to rupture lung tissue when such adhesions are tough and unyielding.

Inasmuch as adhesions are generally least prevalent in the earlier stages of phthisis it might be argued that the first stage cases are most amenable to this treatment. The fact that pneumothorax *can* be easily established in such cases is by no means a proof that it *should* be. These cases are ordinarily cured by methods of hygiene, and there is no reason to believe that pneumothorax therapy should be substituted when suitable institution or home treatment can be carried out. If such means are not at hand in a given case, the pneumothorax treatment may be indicated.

Pneumothorax therapy is especially indicated in that group of cases advanced beyond the promise of relief by methods of hygiene. It is important to recognize this intervening stage before the disease advances to a point at which pneumothorax treatment is undoubtedly attended with less promise. Under present therapeutic conditions when hygienic methods prove unsuccessful, the tendency is to abandon hope and allow the case to progress to a fatal termination.

Our group of cases consists with few exceptions of so-called hopeless cases. Despite the symptomatic relief obtained in a majority of them, permanent relief was obtained in but a small proportion. In selecting material for this treatment a distinction should be made between

those cases which are evidently not responding to hygienic treatment and are then regarded as hopeless, and those very advanced cases which are rapidly approaching their termination. The former group should be treated with pneumothorax, the latter also perhaps for symptomatic relief, but not with the same hope of arresting the disease.

The earlier writers upon this subject, including Forlanini, regarded all bilateral cases as hopeless for compression therapy. The present opinion, however, is almost universal that such cases should not necessarily be excluded. The extent and activity of the process in the opposite lung must of course be the determining factor. If an old process in the opposite side is quiescent there is no contraindication. Our results corroborate the statements of Forlanini, Brauer, Schmidt and Lexer to the effect that a beginning process in the opposite lung is arrested in its activity by the immobilization of the lung most extensively involved. With four exceptions our cases have presented bilateral involvement; sometimes, however, with an inactive process on the side least involved.

It is difficult to explain the apparent effect of a one-sided pneumothorax on the disease of the opposite lung. This problem presents the conflicting theories of mobilization and immobilization, the former represented by Freund's rib-dividing operation to mobilize a threatened or infected apex, the latter supported by the artificial pneumothorax therapy and the extensive rib resections resulting in immobilization.

It is evident that the restriction of respiration of one lung resulting from pneumothorax provokes additional work by the opposite lung. While immobilization of the lower parts of the lung seems to restrict the disease, mobilization of the apex at the early stages tends also to check the disease. If, however, the process of the untreated side

is more extensive, affecting the more mobile parts of the lung, there is no question that the compensatory activity of the unoperated side favours the spread of the disease.

The commonly accepted theory is that the improved general condition and increased resistance of the patient relieved of toxæmia by the pneumothorax therapy, enable him to combat the beginning apical disease of the opposite side.

Certainly the unilateral cases are best adapted and promise the best results, but many of the good results reported by Brauer and Spengler in their series of 102 cases have occurred in bilateral cases. None of our own group were strictly of unilateral involvement and yet the progress of six cases is most promising.

Symptomatic Relief.—Although the amount of autopsy material is insufficient from which to draw final conclusions as to the pathological changes resulting from artificial pneumothorax, the symptomatic relief attendant upon the treatment is unquestionable. This relief of symptoms is entirely in accordance with the pathological changes which appear to exist. The most conspicuous benefit is apparently derived from diminished toxic absorption, not only from the toxins of tuberculosis but of those resulting from the mixed infection present in phthisical cavities. A lowering of temperature is apparent in those cases which have been attended with fever, especially when a considerable amount of gas has been introduced. This fall in temperature sometimes of immediate occurrence after the first injection, may be temporary and followed by return of fever. Subsequent injections tend to lower the temperature at the time and eventually it may remain permanently normal. A diminution in the frequency and extent of night sweats is not infrequently noted. An improvement of the general condition of the patient with increased appetite and gain in weight is undoubtedly further proof of the reduced toxæmia.

A diminution in the quantity of sputum has been the most conspicuous element. Though perhaps increased for the first twenty-four hours after the introduction of pneumothorax, which doubtless results from partial evacuation of cavities under lung compression, there is a subsequent falling off in the twenty-four-hour amount. In addition to the diminution in sputum quantity it is often noticeable that the total number of tubercle bacilli in a given microscopic field is reduced.

Hemoptysis has rarely been present in the cases of our group, and then of slight degree. In two of these the blood promptly disappeared from the sputum and has not since recurred.

It has been interesting and unexplainable to note the relief in coughing. Several patients have voluntarily described soon after the first treatment increased ease in raising the collected sputum. In some instances this was due, perhaps, to the primary increase in the quantity of sputum, its expulsion being favoured by the distal compression. A later alleviation of coughing has been noticeable in certain instances, partly due to the reduction in the quantity of sputum to be raised, and, furthermore, apparently as a result of reduced reflex irritation.

After continued treatment for varying length of time, and a steady improvement in their general condition, certain patients have been enabled to return to work, encouraged not only by increased strength, but by the limited coughing and spitting, which had hitherto rendered them obnoxious to others.

Changes in Clinical Findings.

Physical examination reveals changes varying according to the previously existing conditions, and to the extent

of the pneumothorax established. Numerous fine pleuritic râles may be heard at the periphery of the lung which entirely disappear over the area of pneumothorax. Although this change may be partly due to the fact that such râles are rendered inaudible by the artificially reduced air-space between the chest wall and the lung, we are, nevertheless, persuaded not only that the pleuritic râles disappear as a result of the separation of the pleural layers, but that the intrapulmonary râles are obliterated or diminished as a result of the lung immobilization and the compression of the alveoli.

In cases with previous distinct signs of cavity formation, tubular breathing and cracked-pot sounds cease to exist as long as the compression is maintained by subsequent injections. This factor is consistent with the pathological findings and with the symptomatic relief.

Ordinarily bronchial breathing appears after injection in certain new areas represented by that portion of the lung probably most compressed.

Other changes in breathing and in the nature of râles occur which might be expected from the changes in the shape and mobility of certain portions of the lung, and in the size and contents of the smaller bronchioles resulting from the established pneumothorax.

We have frequently noticed where, previous to operation, the less involved lung had shown evidence of consolidation at the apex with clear bronchial breathing, that, subsequent to the nitrogen injection, this form of breathing became altered to the broncho-vesicular type. Furthermore, the dullness to percussion and the resistance were less marked, and the breathing throughout the remainder of the lung took on a harsh and exaggerated character. The explanation of this change of signs would seem to be that, as the second lung is forced to take up a portion of the work

of the first, it increases in size, and those alveoli which have shown imperfect expansion previously are extended to their utmost capacity. In the area of consolidation where tubercular breathing had been the predominant characteristic, the expansion of hitherto atelectatic vesicles modified the respiratory note, showing clinically what is often found at autopsy—that the extension of a tuberculous process is irregular rather than *en masse*. Not only have there been definite changes in those physical signs denoting consolidation, but, as we have stated before, there has been evidence of marked diminution in pulmonary moisture.

Technique.

Selection of Point of Injection.

To determine, in the presence of tuberculous disease of the lung and pleura, a point at which the pleural layers are not adherent is a task attended with great uncertainty. The percussion note is the most reliable guide. That area presenting the note nearest approaching the normal resonance is most likely to be free of adhesions because of the apparent absence of either a thickened pleura or underlying tuberculous consolidation. A stethoscope may also aid in determining whether the lung is mobile or fixed within a certain area. Auscultatory signs indicating the absence or limited existence of underlying tuberculous disease may aid in designating an area of non-adherent pleura.

If the process is confined to the upper lobe, the nitrogen should be injected in the axilla at the lower portion of the chest. If the lung is apparently adherent posteriorly, the anterior axillary or nipple line should be chosen for a point of injection. If physical signs reveal probable adherence of the lung to the anterior chest wall, with diminished

resonance or tympany posteriorly, the scapular line should be selected.

In other words there are no rules governing the selection of the point of injection other than to choose that area most probably free of adhesions. If it is presumed that the lung is free over a large area, that portion of the chest wall should be selected which is least covered with muscle tissue.

In the absence of contra-indications, the anterior chest in the nipple line on the right or the anterior axillary line on the left are to be preferred.

Thoracotomy or Thoracentesis.

A difference of opinion has existed as to the method of introducing the hollow needle at the first injection. The usual technique of thoracentesis is employed by Forlanini, and with a modification by Schmidt. The so-called Murphy-Brauer method is one of thoracotomy. A $2\frac{1}{2}$ cm. incision is made in the skin and underlying muscle and fascia layers exposing the parietal pleura. A blunt needle is then introduced through the exposed pleura.

This incision method is employed, of course, only at the first injection, the established pneumothorax preventing lung injury at the subsequent injections. This inspection of the parietal pleura at the base of an incision has indeed been most assuring in those cases in which we have employed Brauer's method. A transparent pleura, with the lung surface moving to and fro beneath it, exposes a field through which lung injury is quite impossible. The blunt needle is then inserted at an oblique angle with the parietal pleura, the point sliding between the two pleural surfaces. If a thickened opaque pleura, on the contrary, is discovered at a point where least expected, the needle may be inserted with great care for a distance of $\frac{1}{8}$ of an inch, the syringe

or manometer test (to be referred to later) being then applied before any attempt to introduce the nitrogen is made. Rarely a non-adherent lung may be present beneath a thickened tuberculous pleura and the pleural space found and filled with nitrogen. This is of such rare occurrence, however, that when by Brauer's method a thickened pleura is exposed, it is preferable to close the first incision and make another over a new area.

The point in dispute is whether the danger of injury to the lung is sufficiently great by the blind puncture method to justify the operative method of incision and exposure of the pleura.

The only fatalities attributable to the pneumothorax therapy have resulted from the needle puncture of the lung, with subsequent injection of gas into a pulmonary vessel. One case of hemiplegia and two of air embolism have resulted from this accident—namely, three fatalities in a series of some 500 cases reported.

It may be concluded therefore that avoidance of lung injury renders the treatment a safe one. Forlanini argues that one accustomed to thoracentesis should with some experience be able to recognize that point at which the needle passes the parietal pleura. He cautions, however, against the introduction of nitrogen until further proof has been established that the opening in the needle is not within the lung.

We have employed both methods without a single death or complication. Undoubtedly our experience with the incision method employed on twenty of the cases disclosed to us the exact anatomical pathological conditions present, so that we could more intelligently substitute the puncture technique of Forlanini. It must be admitted that the danger of lung injury by the incision method is reduced to a minimum. Nor can it be denied that, in the hands of one

accustomed to the puncture method and painstaking in its employment, the lung may be avoided. The fact that Forlanini has had no accidents suggesting trauma to the lung may be regarded as proof that he is not only experienced, but cautious. It would be extraordinary if accidents did not occur if a number of operators, untrained in Forlanini's technique, should undertake the free administration of this treatment with no more care than is expended in the common thoracentesis for pus or fluid. A faithful observance of certain methods of determining the position of the needle-point referred to below is essential to avoid accident, and if one is not sufficiently painstaking to observe these rules, he should employ the safer and more reliable incision method.

Granting that the thoracentesis method is safe when correctly employed, there are certain features distinctly in its favour.

The words "operation" and "cutting," employed in explaining to a patient the Murphy-Brauer technique, are often sufficient to discourage him from submitting to treatment. Many suitable cases were sacrificed for this reason when we were employing the incision method. Patients responded far more willingly when it was explained that a needle-prick was the extent of the treatment.

The Brauer operation, though a trifling one, is a time-consuming method. Aseptic technique is essential, and cannot be readily observed under unfavourable surroundings.

Emphysema is of rare occurrence by the Forlanini method, because the opening in the parietal pleura is promptly closed by the overlying tissues.

In at least 60 per cent. of our cases with incisions a greater or less extent of emphysema ensued. This rarely caused discomfort, but indicated the escape of part of the contained gas, and when extensive seemed to interfere with

the first intention healing of the incision. By the operative method the intercostal muscles are sutured over the needle perforation of the pleura. Until these two surfaces have become adherent leakage may occur, resulting in emphysema as high as the neck and face. Emphysema is of rare occurrence by the Forlanini method, and surgical asepsis and after-dressing are obviated.

Being familiar with both methods, we are of the opinion that the Brauer technique at least presents the preferable method for the beginner. He may at least witness in the incision what he must perform blindly in the thoracentesis method. He will further discover how exact must be the position of the eye of the needle in the blind method to permit the introduction of nitrogen at the first injection. It must be remembered that the aspiration of fluid from the chest is quite a different performance from the introduction of a gas. In the former the pleural layers are already separated, and the needle aspiration may be positive almost regardless of the depth of its introduction. At the introduction of gas, however, a pleural space is not entered, but on the other hand the capillarity produced between the pleural layers keeps them in close contact, and the orifice of the needle must be inserted to exactly this point, or the intra-pleural pressure cannot be recorded, nor can the nitrogen be introduced. Undoubtedly the entering needle with its trocar not infrequently pushes the lung from the chest wall, thus separating the pleural layers for a short distance. If, however, the needle is sharp or introduced by the stabbing method, it is more likely to puncture the lung than to force a pleural space.

Anæsthesia.

Whether the thoracotomy of Brauer or the thoracentesis of Forlanini is employed, local anæsthesia is of paramount

importance. Cocaine, even in weak solution, should not be employed in the incision method, at least not without the addition of adrenalin. In six of the earlier cases of this group toxic symptoms developed from the use of cocaine alone. Though harmless in extent, the disturbance was sufficient temporarily to interrupt the procedure, and became a troublesome complication. A solution of 1 per cent. novocain with 1-10,000 adrenalin has proved a desirable substitute in the later cases. No symptoms have occurred with its use. In the incision method the novocain is injected as in any local anæsthesia operation, the layers of the chest wall being anæsthetized in succession. The œdematous infiltration of the muscle layers renders their distinction more difficult, but the rib borders serve as a landmark to the external intercostal layers, and the change in direction of fibres distinguished the internal intercostals. Trauma to the parietal pleura is painful, and care should be taken not to touch the latter in the process of dividing the internal intercostals. A small compress soaked in novocain is then applied with pressure to the parietal pleura for thirty seconds, which is sufficient to render it anæsthetic. The subsequent introduction of the needle is then accomplished without pain.

Novocain should also be employed in the puncture method, although Forlanini does not refer to the use of anæsthesia. Robinson has emphasized the importance of anæsthesia in all forms of thoracentesis, arguing that when the latter is performed for exploration the stabbing method often produces pain which prejudices the patient against subsequent punctures in case the first is negative, and also discourages the operator's persistence to continue exploration until pus is found. In thoracentesis for nitrogen injection it is likewise important not to cause pain. The essential feature of the treatment consists in repeated injections with gas from time to time. If the patient suffers at

the first injection, he may not be persuaded to undergo the subsequent ones; moreover, by relating his experiences he may discourage other members of the same clinic from accepting the treatment.

The skin should be frozen with ethyl chloride, then novocainized. The hypodermic needle inserted at right angles with the skin surface is then gradually forced through the underlying tissues, each introduction of the novocain being followed by an interval of fifteen seconds, in order that the tissues ahead of the needle may be well anæsthetized before it is advanced. Care should be taken that this interval is observed when it is expected that the next advance of the needle will perforate the pleura.

A further important argument in favour of anæsthetic thoracentesis in this treatment is that the subsequent introduction of the nitrogen needle through the anæsthetized channel made by the hypodermic needle may be performed slowly and carefully. A minute skin incision with a narrow double-bladed pointed knife enables the operator to introduce the nitrogen needle without any marked obstruction. One may under these conditions note the slightest resistance of fascia layers, followed by the lack of resistance of the intercostal muscle tissues, warning him that the needle point is approaching the parietal pleura. The resistance of the pleura even when not thickened is then distinguishable, and the sudden ease of advancing the needle beyond indicates to the operator that the pleural cavity is entered and that further advance endangers the lung. At this point he employs a method described below of proving further that the opening of the needle is between the pleural layers.

Anæsthetic thoracentesis also enables one to avoid the under surface of the rib above, thus diminishing the possibility of injury to the intercostal vessels.

The usual stabbing method of thoracentesis is then

distinctly to be avoided in this treatment, because of physical and æsthetic injury to the patient, and because of the added danger of lung injury from the lack of absolute control of the depth of introduction.

To confirm the correct Depth of the Needle-point.

If the incision method of Brauer has been employed and the parietal pleura is found to be transparent and non-adherent, the needle may be slipped in between the pleural layers and the nitrogen injected without further delay. If, on the contrary, the direct thoracentesis method has been substituted, one must have ample evidence before introducing the nitrogen that the eye of the needle is between the pleural layers. Forlanini's method of attaching a syringe to the butt of the needle is perhaps a less complete precaution than the use of a manometer. We have employed the manometer in all the cases of this group and have found it to be an accurate guide.

When the needle has been inserted to what digital sense would indicate to be the correct depth, the trocar is removed and the needle-cock closed. The rubber tubing leading from the apparatus is supplied with a bevelled metal tip, which forms a tight joint when inserted into the base of the needle. Before making this connection, the apparatus cocks are so arranged that the manometer is isolated from the nitrogen circuit. After connecting the tubing with the needle the needle-cock is opened. If the operator has been fortunate enough to insert the needle to the correct depth the negative intrathoracic pressure is recorded by the manometer; and inasmuch as this negative pressure varies at inspiration and expiration, an oscillation of the water-column is visible and coincident with the respiratory movements. If the needle-point is partly obstructed by contact with adhesions or lung tissue, this oscillation may not be more than $\frac{1}{2}$ cm. Such a trifling oscillation is also found

when the pleural space entered is one of small capacity on account of neighbouring adhesions; but whether this oscillation be a complete or restricted one, its presence is an unerring guide that nitrogen may then be safely introduced. If the oscillation has been small, the amount of nitrogen injected is correspondingly low. A free oscillation of 3 to 4 cm. is evidence of greater lung mobility, and the extent of the pneumothorax produced is correspondingly greater. On two occasions we have risked the connection of the nitrogen pressure in spite of the lack of this manometer reading. A slow nitrogen flow in one instance followed, and after introduction of 50 c.c. the cocks were again adjusted to connect with the manometer. To our surprise a respiratory oscillation was then manifest. The explanation of this occurrence rests in the fact that the gas entering under slight pressure forced from the eye of the needle whatever may have previously been in contact with it, presumably the visceral pleura. Despite the success of this adventure its danger was unquestionable, a direct introduction of nitrogen into a vein being one of the alternatives which might have occurred. *This is an unnecessary and unwarranted risk.* A slight movement of the needle either inwards or outwards will bring the needle opening to the desired point with resulting oscillation of the manometer, unless adhesions are present. If these painstaking changes in the position of the needle do not result in a positive manometer reading, even when the patient is requested to perform deep breathing, ample proof is present that a pleural space and pneumothorax cannot be established at the point, and the needle should be withdrawn and another area selected.

Nitrogen Pressure.

Having obtained the desired respiratory oscillation of the manometer, the apparatus cocks are so adjusted that

the manometer circuit is cut out and the nitrogen gas may then enter the needle. If the displacement of nitrogen in the reservoir occurs rapidly it is advisable to partially close the needle-cock in order that the pneumothorax and retraction of the lung may not occur too suddenly.

It will be noted in the case reports that the nitrogen pressure employed has not been expressed in manometer readings. The pressure employed has been varied at will according to the conditions present. Time was not taken at each of these alterations to arrange the cocks to connect with the manometer. A pressure of 12 cm. of water was in no case exceeded. If nitrogen will not flow under this pressure the undertaking may be abandoned, even though a respiratory excursion of the manometer is previously obtained. Under favourable conditions the nitrogen gas will enter at the rate of 50 c.c. per minute under a pressure of 6-10 cm. of water. A more rapid flow and a higher pressure means economy of time, but a patient reacts less to the altered conditions within the thorax if they occur gradually.

Not infrequently, even though the needle be properly adjusted, as proved by the manometer oscillations, the nitrogen will flow more slowly. Increasing the pressure under these conditions will generally accelerate the flow. We regard this phenomenon as evidence that the pleural space entered is one limited by adhesions and that the subsequent pneumothorax will be a slight one. In three cases it has happened that as many as 1,000 c.c. of nitrogen have been injected with this increase in pressure, and in these instances it would seem that the pleural space was not restricted, but that the opening in the needle may have been partially obstructed.

Quantity of Nitrogen.

A not uncommon question by witnesses of this treatment is, how much nitrogen should be injected at each sitting?

There is no answer to this question since the amount of nitrogen injected will always depend within certain limits upon the conditions found in a given case. If the nitrogen flow under moderate pressure is apparently unrestricted, 600 to 800, or even 1,000 c.c., may be injected at the first operation. Forlanini habitually employs a moderate injection at first. Though inclined to adopt this technique in our earlier cases we are convinced that at least 600 c.c. is frequently well tolerated, and that the relief of symptoms so necessary for the encouragement of the patient is more marked if the first injection is a generous one.

In those cases apparently free of adhesions, 600 to 1,000 c.c. may be introduced at the first injection without the least discomfort; the respirations are slightly increased and the patient is aware of an altered condition in the chest. The pain may not even be suggested; 1,000 c.c. should be the limit of injection at the first sitting, even in the absence of symptoms.

If, on the contrary, physical signs, difficulty in adjusting the needle-point, and slight respiratory oscillation of the manometer and retarded nitrogen flow indicate the probability of a limited degree of pneumothorax, one should be guided by the degree of discomfort to the patient. Generally in such cases the entrance of the nitrogen, despite a gradual increase in pressure, becomes steadily retarded. Concurrent with this diminution in flow is some indication of distress. The patient describes a full or tense feeling in the chest, generally at once relieved by temporarily checking the flow. Upon renewing it the symptom recurs and may later result in a distinct pain, which is identical with the ordinary pleurisy pain. This is generally noted in the lower chest anteriorly in the region of the diaphragm. The small area of pneumothorax established in such cases is often limited below by adhesion between the lower lobe

and the diaphragm. Tension of this adhesion upon the diaphragm is subjectively expressed by pain. If, on the contrary, the diaphragmatic surface is clear, the process being confined to the upper lobe, a greater amount of nitrogen can be injected and pain does not develop. The onset of distress and the first sign of pain should be accepted as sufficient reason for removing the needle not only at the first injection, but in subsequent ones. Whatever actual pain occurs is bound to increase if the flow is continued, and, furthermore, even when the treatment is promptly suspended whatever pleurisy pain exists at the time will continue for at least three to four hours.

Ordinarily a larger pneumothorax may be established at the second and third injections than at the first. If the pleural space seems comparatively unrestricted, 1,200 to 1,800 c.c. may be injected. If in the restricted cases symptoms have occurred after the introduction of a limited quantity (200 to 400 c.c.), it is not uncommon to find that even 600 to 800 c.c. may be tolerated at the second and third injections without the recurrence of the same symptoms. This phenomenon is explained in a previous paragraph. The amount of the previous injection, therefore, should be regarded as a guide, but not as a restricted limit to the amount of later injections.

Frequency of Treatments.

It would seem that the tendency of the lung to re-expand is gradually reduced as time elapses. Nitrogen, furthermore, is apparently more rapidly absorbed in certain patients than in others, and any dilution of the gas, either in its manufacture or in its introduction, will, of course, hasten its absorption.

Concerning the frequency of treatments, again no rule

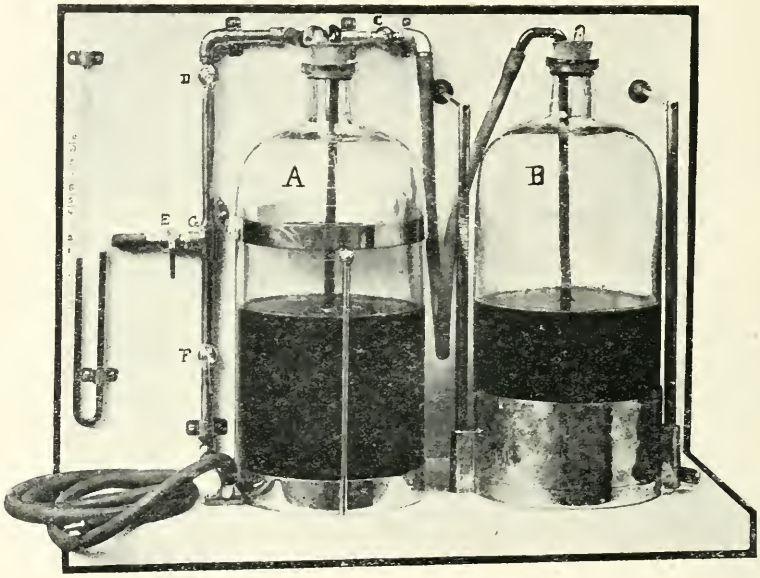
can be established. Generally speaking, the cases with restricted pleural space in which the first treatment results in a limited pneumothorax should be treated again within a week, the frequency of subsequent injections depending upon whether the quantity of nitrogen tolerated gradually increases. If a first treatment indicates that a considerable pneumothorax can be established, two or three weeks may be allowed to intervene before a second treatment. The symptoms of the patient and the size of the tympanitic area representing the pneumothorax are contributory evidence as to the permissible interval between injections. In cases in which 800 to 1,200 c.c. have been introduced at the third injection, a month or six weeks may be allowed to intervene between the later ones.

Apparatus.

The accompanying photograph of Robinson's apparatus illustrates the principles employed in all forms of apparatus. Two bottles of 3,500 c.c. capacity are employed. One is stationary and filled with water containing 2 dr. of pyrogallic acid to take up any oxygen which may enter in conjunction with nitrogen. Nitrogen gas is then forced into the stationary bottle (A), displacing the water back to bottle B. At completion of this displacement the apparatus is ready for use. Upon opening certain cocks the water in bottle B replaces the nitrogen in bottle A, gradually filling it. The difference in the water-levels of the two bottles represents the pressure under which the nitrogen is injected, the rapidity of its injection being regulated by the size of the opening in any one of the cocks. When bottle B is full the maximum pressure is obtained, amounting to about 14 c.c. of water. As the water-levels approach one another bottle B may be raised, thus maintaining the pressure until most of the nitrogen

has been displaced, when the pressure is necessarily reduced. With this hydrostatic mechanism the pressure may be varied at will, never attaining the dangerous limit.

The arrangement of cocks D, E, and F, correspond to the substitution of a three-way cock at point G. In other words, with the cock D closed, and E and F open, a direct connection is established between the thoracic cavity and the



Robinson's apparatus for nitrogen injection to establish artificial pneumothorax.

manometer. With cock F closed, and C, D, and E open, connection is made between the confined nitrogen and the manometer, thus recording the pressure represented by the difference in water-levels of bottles A and B. With cock E closed and all others open the nitrogen passes directly from bottle A into the pleural cavity.

The advantages in Robinson's apparatus seem to exist

in its stability and portability. The fixation of all cocks and tubing to the back-board facilitates their opening and closure, while the use of rubber tubing with clips, such as we employed in earlier apparatus, proved a constant source of annoyance. The entire apparatus is carried in a box with no danger of breakage either to bottles or manometer.

Discussion of Cases and Conclusions.

The following twenty-eight cases of phthisis have been subjected by the writers to artificial pneumothorax therapy within the past two and a half years. With three exceptions all of the cases have been advanced ones, which had previously failed to respond to methods of therapeutic hygiene.

The last eight cases have been treated by nitrogen injection too recently to draw conclusions as to the ultimate result of the treatment. It may be said, however, that with the exception of the three cases in which a pleural space could not be established, a distinct relief of symptoms has been the immediate result of the lung compression in practically all of the reported cases of our series.

The tuberculous process has been brought to a standstill in at least six of the cases which have been under constant observation and continued treatment. In two instances there has been cessation of all activity in both lungs.

The promptness and willingness with which most of the patients responded to summons for repeated injections were conclusive evidence at least of the symptomatic relief attending the therapy. This might have been credited in part to physic influences had there not been a corresponding improvement in the objective signs revealed by repeated examinations.

From experience with the earlier cases we have been led to the employment of more frequent injections. It cannot be denied that this factor is of paramount importance. The completeness of the compression is thus more neatly attained; furthermore, the partial mobilization of the lung permitted by the absorption of the nitrogen is promptly prevented by its early renewal.

The fatalities recorded were due to the unarrested progress of the disease in certain of the more advanced cases. In no instance was death referable in any way to the pneumothorax therapy.

"Pleural Eclampsia" (Forlanini), or a reflex inhibition of the heart through vagus irritation from the pleura is a danger to be considered in this treatment, as in other therapy requiring thoracentesis. We believe that it may always be prevented by anæsthetizing the pleura, as described in a previous paragraph.

Air-embolism may result from the direct introduction of gas into a pulmonary vein. This should never occur if the technique described above is faithfully observed.

We have experienced no accidents, and believing that they are always avoidable, we conclude that pneumothorax therapy is a safe procedure.

Pulmonary tuberculosis, when essentially unilateral, and resistant to hygienic treatment, is in a certain number of cases arrested by the continuous employment of artificial pneumothorax therapy. Our treatment has been of insufficient duration to permit us to claim a permanent cure in any one case. We believe that such is possible, however, as proved by the recent reports of Brauer and Spengler.

We conclude, therefore, that artificial pneumothorax is entitled to definite recognition in the treatment of pulmonary tuberculosis.

Case No. 1.—B. M., female, age 28, single; born in Ireland; occupation, waitress. Following notes from typewritten extract from records of Good Samaritan Hospital:—

Family History.—One sister died of phthisis ten years ago.

Past History.—Always well.

Present Illness.—Felt well and worked until a few weeks ago. At that time took cold and began to lose weight and strength. Cough and expectoration developed and have steadily increased since. Night sweats present. No hæmoptysis. Has lost 20 lb. in five weeks. Some dyspnœa. Appetite fair. Bowels constipated. No thoracic pain. Periods regular.

Physical Examination.—Fairly developed; poorly nourished; colour good; skin negative; teeth poor. Pupils equal and react to light. Tongue clean. Throat reddened and chronically inflamed. Tonsils not enlarged. Chest fairly well developed. Marked depression above and below clavicles. *Heart*: Maximum impulse on lying down, fourth space, $2\frac{1}{2}$ in. left of median line. Left border of dullness, fifth space, 4 in. left of median line. Right border $\frac{1}{2}$ in. right of median line. Upper border third rib. Rhythm regular rapid. Diastole short. First sound at apex accentuated. Pulmonic second sound slightly increased. No murmurs. Pulse regular, small volume, low tension. Artery wall not thickened.

Lungs: Left side moves more than right. Above second rib in right front dullness, increased resistance to percussion, increased vocal fremitus and bronchial breathing. Scattered coarse moist râles. Throughout the right back dullness, increased resistance, especially at base. Percussion note at apex slightly tympanitic. Vocal and tactile fremitus, slightly increased over upper two-thirds; tactile fremitus diminished over lower third. Breathing bronchial over upper two lobes, changing to almost amphoric over lower lobe, in which area also cracked-pot note is obtained. Scattered moist râles through the back.

In the left chest above the second rib in front and the mid-scapular region behind there is dullness, increased resistance to percussion, diminished tactile fremitus. Breathing broncho-vesicular, except at apex, where it is bronchial. Scattered coarse moist râles over this area. Breathing and

percussion note, especially in lower two-thirds of left lung at right base. Practically no apical expansion on either side.

Abdomen: Flat, held firmly, tympanitic, no masses or tenderness. Liver and spleen not enlarged. Few small axillary and inguinal glands. Extremities negative. No œdema. Weight, 95⅞ lb.

September 6, 1909.—Breathing excites pain in right axilla. Friction sound heard. Patient admitted to tent ward at 11.30 a.m., having been brought from the Good Samaritan Hospital in the ambulance. After admission patient coughed a good deal. No sputum raised, however. Patient coughed three times during the night with no sputum. Slept seven hours. X-ray plate taken before operation.

September 7, 1909. *Operation for Artificial Pneumothorax.*—Patient placed in left lateral position with right arm raised above head. Morphia 1/8 gr. given subcutaneously before the operation. An area was then cleaned and cocainized in the eighth intercostal space about 1½ in. below the inferior angle of the scapula. Following a skin incision of 2 in. the latissimus fibres were cut across, and also a thin layer of fibres below it. On exposure of the intercostals the latter were cocainized and incised for a shorter distance. When the intercostal fascia was exposed, the lung could not be seen sliding beneath the pleura, and it was suspected that adhesions would be met with. An error was made in incising and not nicking the fascia and pleura, for suddenly a gush and suction of air revealed the opening of the inadherent pleura, and it was then discovered that there was a short rent of ⅛ in., which was larger than necessary for the entrance of a blunt-pointed needle. This split of the pleura was, during the subsequent injection of nitrogen, somewhat enlarged. Finally, it was necessary to take two catgut stitches in the intercostal muscles on either side of the pleural opening in order to prevent the escape of air or nitrogen around the needle. During the injection of 700 c.c. of nitrogen a small area of emphysema developed below the wound, but too small an area to lead one to suppose that the nitrogen had all gone into the tissues and only a small amount into the pleural cavity. There was undoubtedly, however, a considerable space left between the external

intercostal fibres and the hole in the pleura, and, inasmuch as the former were not tightly sutured, it was expected that considerable emphysema would develop. The other muscle layers were then sutured with interrupted plain catgut, and the skin with the same material. Adhesive was placed over a cocoon applied to the incision. The strips were wide, and extended from the vertebral column almost to the median line in front. Patient returned from the operation-room in good condition. Complains of feeling weak. No pain. Coughs very little. No sputum raised. Ate soft solids for dinner with fair appetite. At 5.30 patient complained of stiffness in neck, and pain developed in the same region. Neck was bandaged in cotton and a hot-water bottle applied.

September 15, 1909.—Night after operation, temperature at 11 p.m., 101.8° F. Pulse at midnight, 125. On examination of neck it was found that emphysema was present in the right pectoral region, extending also into the front and back of the right neck. The emphysematous areas were somewhat tender to touch. The bandage was reapplied, and patient kept as quiet as possible. Rest of night more comfortable. Coughed three times during the night. Coughed frequently at 5.30 a.m. Complained less of discomfort in neck this morning. Emphysema not increasing or diminishing. Comfortable afternoon. Examination of lungs shows signs on the right. One inch below spine of scapula on right behind and clavicle in front there is a tympanitic note to percussion diminishing as level of dullness is reached. Note tympanitic well into vault of axilla. Tactile fremitus almost absent in front of chest, and extends to 1½ in. below spine behind. Resistance above spine on percussion less marked. No râles. Vocal fremitus nearly absent over tympanitic area. Breathing broncho-vesicular along spine instead of bronchial, and distant (faint) bronchial along spine below spine of scapula. Chest moves some with respiration on right. Heart area of dullness; right border at left border of sternum and left border 1 in. outside of nipple. Sounds regular and good quality. Elasticity good over tympanitic area. Lung evidently compressed towards the spine from the front of the chest.

September 16, 1909.—Second night after operation.

Slept nine hours. No pain. Temperature at 8 p.m., 102° F. Pulse 110. Respirations 37. Patient comfortable, not complaining of pain. Sat up in chair for 1½ hours in the afternoon.

On removing dressing and adhesive plaster, the wound was found moist from sweating of adhesive. In one end of the wound were two drops of pus which seemed to be in the skin above.

Physical Examination.—General condition good. No expectoration for twenty-four hours.

Examination.—Heart: Right border at left of sternum. Left border ½ in. outside nipple, where impulse is felt. Cardiac sounds are good. *Lungs:* Breathing in left front broncho-vesicular. No râles. Same in back. In right front, dullness above clavicle. Note below slight tympanitic. Breathing fair and heard throughout right front—bronchial just below and above clavicle, normal below. Vocal and tactile fremitus increased above third rib, and over this area few fine pleural râles. All signs most marked above clavicle. In right back signs of consolidation above spine of scapula. Between angle and spinal column, area 2 by 2, with intense bronchial breathing, almost cavernous, and weak tactile fremitus. Otherwise note to percussion tympanitic and numerous fine dry râles. Over tympanitic area respiration very distant.

September 17, 1909.—Third night after operation. Slept nine hours. Temperature at 8 p.m., 102.2° F. Pulse, 128. Respirations 30. Coughed very little. Patient states that she has breathed easier since the operation, especially at night. X-ray taken to-day. Patient discharged, and sent back to Good Samaritan Hospital in the afternoon; stitches out of wound.

September 27, 1909.—Dr. Robinson again inserted needle and injected about 700 c.c. of nitrogen into the right pleural sac. Patient comfortable, chest expansion showed tympany with diminished breathing and voice-sounds throughout right front to apex, and in right axilla and back up to level of lower one-third of scapula; above that dullness increased, fremitus and whisper and bronchial breathing. Peculiar voice-sounds resembling bronchophony just above right clavicle. Breathing exaggerated on left cardiac, dullness left border.

October 4, 1909, weight 100½ lb.; October 11, weight 100¾ lb.; October 18, weight 104¾ lb.; October 25, weight 110⅛ lb. Looks and feels much better, sleeping out. Area of tympany at upper chest front still present.

November 18, 1909.—Very little tympany in chest. Dr. Robinson introduced 900 c.c. of nitrogen into the pleural cavity without incident.

November 29, 1909.—No effect from the introduction of nitrogen. Kept quiet in bed for two or three days, and then allowed up only for meals. Temperature still up and down; very little cough, no sputum.

December 19, 1909.—Feels well; bowels regular, appetite good; quite bad cough.

February 10, 1910.—Dr. Robinson injected 900 c.c. of nitrogen gas into the pleural cavity. This made the patient much easier, with less coughing; eats well; sleeps well.

March 17, 1910.—Physical examination unchanged. Sputum positive; amount in twenty-four hours about ½ oz.

April 25, 1910.—For the past week stomach has been upset and has been running temperature, and has remained in bed. To-day stomach is better and takes more food.

May 30, 1910.—Patient feeling well, with exception of a few pains in right shoulder. Cough slight; very little expectoration. Examination of lungs shows at the left apex that there are signs of consolidation, with retraction of the lung. Very little evidence of moisture. On the right side, above the fourth rib in front and the angle of the scapula behind, there is dullness, increased resistance, vocal and tactile fremitus increased, bronchial breathing, which is amphoric in the middle of the right back. An occasional scattered râle occurs in this area. Nitrogen has been all absorbed. There is very little evidence of activity, and the general condition of the patient is much improved.

July 5, 1910.—Patient has been doing well for the past few weeks, and, except for slight pain in the right shoulder, has no symptoms. Except for moderate morning expectoration, there is very little discharge from the lungs.

July 13, 1910.—To-day, without warning, patient was taken with sudden severe hæmorrhage, about a quart of blood being lost in all. About four hours later the patient died.

Discussion.—This case was one of rapidly advancing

pulmonary disease which in a short period of time had all the appearances of an advanced case. The effect of the injections of nitrogen has been to retard the process which had been advancing rapidly. Cough and expectoration, together with other symptoms, had much diminished, and following each treatment improvement was noticed. We feel that in this case artificial pneumothorax was of real aid in prolonging life.

Case 2.—L. H. S., female, white, married, age 29 years; occupation, shoe inspector.

Family History.—Negative.

Past History.—Operation for gall-stones one year ago. Has one child.

Present Illness.—About two years ago, after coughing one week, had a hæmorrhage of about one pint. Has coughed off and on for about two years, and expectorates from 1 to 3 oz. of sputum daily. There have been some pleuritic pains in the chest, and in the course of two years the patient has lost about 30 lb.

Physical Examination.—Fairly well developed and nourished. Colour fair. Heart not remarkable. Abdomen not remarkable. Chest symmetrical, very little retraction. On the left side, above the third rib in front and the fourth rib behind, there is dullness, increased vocal and tactile fremitus, broncho-vesicular breathing, and a few moist râles. On the right side, above the fourth rib in front and throughout the back, there is dullness, slightly increased vocal and tactile fremitus, broncho-vesicular breathing at the apex, and a few fine and many coarse râles. Sputum is muco-purulent; amount in twenty-four hours, from 2 to 7 dr. Many tubercle bacilli present. Urine negative.

September 16, 1909. *Operation*.—Patient placed in the left semi-recumbent position. Right arm was raised above level of head, and an area in eighth intercostal space in region of angle of scapula was cocainized. Incision of $1\frac{1}{2}$ in. was made, and carried down through intercostal muscles to the pleura, which was exposed. A Brauer needle was then inserted through the pleura. On deep inspiration there was less suction of air than usual in the absence of adhesions. The needle was connected with a fluid manometer, but no respiratory excursion was obtained. In the hope that the

parietal pleura might be dissected away from the visceral pleura, the needle was carried down about 1½ in., parallel with the chest wall. The sensation obtained was that of going through solid lung tissue. No bleeding followed this procedure. The wound was then closed in layers and external pressure applied by means of the Lemke dressing.

September 17: The second operation was decided upon, following the failure of the first attempt. The area selected was in the anterior axillary line in the fifth intercostal space. Under cocaine, an incision of 2 in. in length was made, being carried through the intercostal muscles down to the intercostal fascia. This was divided and the pleura exposed. The latter was then punctured with a sharp needle, and through this opening a dull needle was inserted. This met with considerable resistance, suggesting either a thickened pleura or an adherent lung. An attempt was then made to separate the various pleural layers with the needle, hoping to find the pleural space. The needle was also carried to a depth of one and one-half inches downward through the thickened pluera, without finding any free space. This proved conclusively that at least in this region the pleural surfaces were adherent, and our lack of success was not merely on account of a thickened pleura. In suturing the wound in layers it was surprising to note a slight entrance and exit of air on inspiration and expiration. No other explanation can be offered than that the parietal pleura had perhaps been peeled away from the fascia, leaving a localized dead space, which was filled and emptied with respiratory movements. Following the second operation, cough and expectoration were much increased. On the following day considerable emphysema was noticed, as after the first operation, over the right pectoral region, but not above the clavicle.

Subsequent History.—September 19: Sluggish sepsis developed in both wounds following the emphysema, probably due to filling the air space in the wound with purulent serum. September 20: Wound dressed daily and it rapidly healed up.

Discussion.—This case was one which was entirely unfavourable for treatment by artificial pneumothorax on account of the obliteration of the pleural cavity. Had retraction of the lung been possible as a result of pulmonary

pressure, the course of the disease might have been favourably influenced.

Case 3.—J. J. S., male, white.

Family History.—Mother died of pneumonia. Father living and well. One brother has lung trouble. One brother living and well. Aunt who lived with patient died three and a half years ago (aged 67) of lung trouble. No heart trouble or cancer.

Past History.—Bronchitis in infancy; measles, scarlet fever, tonsilitis, rheumatism; typhoid fever four years ago; pleurisy. Denies venereal. No tobacco or alcohol.

Present Illness.—For five months has had a cough, raising a greenish white expectoration, never raised any blood. Had had night sweats for three weeks. For last week after eating has dizzy spells with headache, belching some gas. Appetite fair, bowels regular, sleeps well. Has lost 12 lb. (The above histories were obtained in April, 1907.)

Physical Examination.—Fairly well developed and nourished. Colour fair. Skin negative. Few small glands, cervical, axillary and inguinal. Chest fairly well developed. Depression above and below clavicle; atrophy of shoulder muscles. Chest flattened below clavicle, especially on right. Expansion limited especially on right. *Heart:* Sounds fair quality. Rhythm regular. No murmurs. Right border 1½ cm. to right of mid-sternum. Left border in nipple line.

Lungs.—Above second interspace in left front and mid-scapular region, behind there is dullness, increased resistance, bronchial breathing with amphoric quality at apex in front. Increased vocal fremitus, scattered coarse and few fine moist râles, most marked in mid-left back. Retraction of apex marked. No expansion. Apical outline is narrowed on both sides. On right above third rib in front, 2 cm. above angle of scapula behind, there is dullness, increased resistance, bronchial breathing at apex with amphoric breathing in mid-scapular region, and in axillary line in front. Cracked-pot note present.

Vocal and tactile fremitus increased over dull area. Coarse and medium moist râles over upper two-thirds of lung and fine pleural râles all over lower lobes. Process much more extensive and active on right with probable

cavity formation. Bronchial vesicular breathing at left base (compensatory).

Operation.—September 8, 1909. Patient on left side, semi-recumbent position. Right chest prepared. Two-inch incision (with ½ per cent. cocaine), in eighth interspace parallel to ribs. Latissimus dorsi and serratus fibres divided transversely, also intercostal and fascia covering pleura. Cocaine used in deep parts. No pain until pleura was approached. Latter cocainized with compression. Lung seen moving under pleura. Small nick made with scalpel and at first no air escaped. Patient coughed and there was cracking. Blunt needle inserted and 600 c.c. of nitrogen injected with two pauses. Patient complained at this moment of pain in right chest, anteriorly and low down. Pain increased during suture and went to right upper chest. Adhesive strapping relieved somewhat. Colour was somewhat anæmic at this time, but pulse good.

Examination of chest immediately after operation. Respiratory murmurs much increased on left. On right heart not displaced. On right râles much fewer. Pleural râles gone. Friction rub over fourth rib in front. Vocal and tactile fremitus much diminished up to clavicle and spine of scapula. Dullness and resistance less at apex, but still present. Below mid-scapula note to percussion hyperresonant, but not tympanitic. Heart in normal position. Few râles present at left front. Vocal and tactile fremitus now normal. Breathing distantly amphoric. Friction in right front. On return from operation patient complained of pain in right chest, especially in the lower part. In three hours after operation no coughing. During the day respiration varied from 34 to 37. Pain more or less severe, but less so in afternoon. Sputum in twenty-four hours, 3 dr.

Subsequent History.—Night after operation complained twice of pleurisy pain in right chest, promoted by coughing. September 9: Patient more comfortable. No pain except when coughing. States that breathing seems easier than before operation. In afternoon an attack of pain; soon relieved. At each period of coughing, some sputum. Second night after operation, pain in left chest persisted through first part of night. Raised sputum at 2 a.m. Slept well after 3 a.m. Sputum in twenty-four

hours, 6 dr. During day coughed less and raised less sputum. September 11: Third night after operation. Patient coughed once during the night and did not complain of any pain. No sputum raised. Sputum in past twenty-four hours, 2 dr. September 12: Coughed frequently during the night and raised considerable sputum.

Physical Examination. — General condition fair. Stronger. Pain on deep inspiration only slight. Heart not remarkable. Lungs: Left chest fuller than right, latter moving hardly any. On left area of dullness unchanged. Râles in left front dry and fewer. On right dullness above spine of scapula behind and second rib front. Pleural râles and tactile fremitus distinctly felt and heard nearly to base behind. In front vocal and tactile fremitus much diminished. Breathing faint.

September 15: Examination. Tympanitic area in right back now as high as lower angle of scapula. Over area of tympany breathing scarcely heard, fine crackles everywhere. Right heart border at right sternum border, percussion of two sides in front very similar. On right, region of third rib (anterior axilla fold) bronchial breathing and area of tympany.

September 23: Following the injection of nitrogen on September 8, the X-ray showed the lung markedly retracted toward the mediastinum. A wall of adhesions extending from the lung to the diaphragm was clearly shown. Four days ago nitrogen was again injected, and about 400 c.c. was given. There was less pain subsequent to this treatment and cough and expectoration were considerably improved. October 12: Weight 113½ lb. Pulse and temperature have been normal. Patient has felt decidedly better, coughs only in the morning and evening. Above the first rib in the left front and the spine of scapula behind there is dullness, increased vocal and tactile fremitus. Similar signs are present over the upper lobe on the right side, together with an occasional dry râle. Over the lower lobe on the right there is some dullness, diminished breathing and vocal fremitus. Numerous medium moist râles. December 9: Weight 110 lb. Patient was much exhausted for twenty-four hours after last injection. Following this he began to raise pus which continued for two weeks, almost 10 oz. being raised daily. At present he is raising only

2 oz. of sputum in every twenty-four hours. *Note.*—The above condition is probably explained by the retention of secretion in a cavity following lung compression. December 14: On the left side above the third rib front and fourth behind there is dullness, bronchial breathing, and increased vocal and tactile fremitus. Percussion note over the rest of the chest almost tympanitic. Respiration harsh. On the right side over the upper lobe there are signs of consolidation with retraction and a few coarse râles. Signs of cavity formation are much less marked. Over the lower two-thirds of the chest respiratory and voice sounds are much diminished and percussion note is tympanitic. January 17, 1910: The patient was given an injection of 900 c.c. of nitrogen, which was followed by severe pain localized in the vicinity of the diaphragm on the right side. January 27: On the left side of the chest, signs of consolidation persist, no activity. On the right side, over the upper two lobes, signs of consolidation persist with evidence of cavity formation below the clavicle in right front, which are not marked. Only a few coarse râles are present over this area; at the right base respiration has diminished, there is some dullness on percussion with a few fine pleural râles. Examination shows that there has been no advance in the disease during the last three months, and the process is more nearly quiescent than at any time since the patient first reported at the hospital. February 1: Following the last injection, cough was much increased, there was some shortness of breath and the amount of expectoration increased to about 4 oz. daily. There has been some elevation of pulse and temperature. April 30: Patient has not been able to report since last note on account of being somewhat used up by the last treatment of nitrogen. He is at present feeling fairly well. Weight has remained constant and he is coughing only in the morning and at night. May 10: Weight 111 lb. Cough dry, raises only a little in the morning, and feels fairly well. Refuses to have any further treatment with nitrogen. January 21, 1911: Patient has been under observation at the North Reading Sanatorium, has been slowly losing ground, and at present is unable to report to the hospital.

Discussion.—In this case the pulmonary lesion was too far advanced to be permanently benefited by the use of

pneumothorax therapy. While following nearly every injection there was some increase of symptoms, this was not lasting. The effect of pressure upon emptying the lung cavities of sputum was of interest. Had the patient been under more immediate control the probable outcome in this case might have been still further delayed, as the result of the first six months of treatment had practically brought the process in the lung to a standstill.

Case 4.—H. C., male, white, single, aged 20 years. Born in Quincy, Mass. Occupation, stone-cutter.

Family History and Past History.—Negative.

Present Illness.—For about a year patient was troubled with cough accompanied by considerable expectoration, which has been steadily increasing. There were frequent slight sweats and considerable loss of weight. At time of first examination patient felt poorly with very little strength.

Physical Examination.—September 21, 1909: Poorly developed and nourished. Colour fair. Chest narrow, showing considerable flattening and retraction below the right clavicle; expansion of the lungs poor, especially at the right base. Apices are retracted, the left chest above the second rib in front, and mid-scapula behind, there is dullness, bronchial breathing, increased tactile and vocal fremitus, most marked at the apex, gradually diminishing in intensity to the lower border of dullness. An occasional dry râle heard over this area. Cracked-pot note heard beneath the left clavicle and at the left apex. On the right above the third rib in front and throughout the back there is dullness, bronchial breathing, and scattered dry râles. Vocal and tactile fremitus are increased from the apex down as far as the region of mid-scapula, cracked-pot note and amphoric breathing obtained above the second rib in right front. Heart shows displacement toward right side, with its left border being $1\frac{3}{4}$ in. to the left of the median line.

Operation.—September 22, 1909: The anterior part of the right thorax was selected as an area most probably free from adhesions, and under cocaine an incision $1\frac{1}{2}$ in. long was made in the fifth intercostal space between the anterior axillary and mammary lines. Incision was carried down to the pleura through the intercostal muscles and this was

punctured with a sharp needle. This was followed by a blunt needle and the pleural space entered without difficulty. Nitrogen gas was then allowed to enter under a slight hydrostatic pressure. During the injection pulse-rate slowly became more rapid, and the patient complained of a heavy feeling in the right thorax. After an introduction of 800 c.c. of nitrogen, the incision was closed.

Examination following operation showed right border of the heart to be $1\frac{1}{4}$ in. to the right of the median line, and the left border $2\frac{3}{4}$ in. to the left in the fourth space. Over the left lung respiratory note had changed from bronchial to broncho-vesicular, except at the apex where it is less intense. There are no râles. On the right side there is a tympanitic note to percussion below the third rib, right front, and 2 in. above the angle of the scapula behind. Over this area respiratory sounds are very distinct and vocal fremitus faint, tactile fremitus is absent. Below the clavicle in right front the signs of cavity have disappeared and there is no amphoric breathing; a few râles persist at the right apex. During the night patient raised about $1\frac{1}{2}$ oz. of sputum and suffered from some discomfort about the wound, and difficulty in breathing on account of emphysema.

Subsequent History.—September 25: Since operation, patient has been more comfortable, there has been less cough and the expectoration is gradually diminishing in quantity.

September 28: Wound entirely clean and healing readily, cough and expectoration diminishing. Patient feels somewhat better as a result of treatment. By means of thoracentesis in the region of the wound patient was re-inoculated to-day with 400 c.c. of nitrogen without unfavourable symptoms. Following this last injection patient returned home from the Massachusetts General Hospital; and while there was some temporary improvement in his condition, the disease has steadily advanced. Heart action has been somewhat embarrassed on account of the artificial pneumothorax, and patient has been unable, on account of continued temperature and marked debility, to continue the treatment further. After about three months the patient died.

Discussion.—This case was one in which there was a marked bilateral pulmonary process with dextro-cardia,

which was not materially affected as the result of pulmonary compression.

Case 5.—A. M., male, white, married, aged 36. Occupation, plasterer.

Family History.—Negative.

Past History.—Pneumonia fifteen years ago.

Present Illness.—Began four weeks previous to October 8, 1909. Onset with cough and hæmorrhage. No night sweats, no chills; occasional dyspnœa. Tubercle bacilli in sputum, October 13, 1909.

Physical Examination.—Throat examination, chronic laryngitis. (T.B.?) Deviation of septum to right. Poorly developed and nourished. Weight 145¼ lb. Temperature, 98.4° F. Pulse, 118. Colour of mucous membranes pale. Skin negative. Tongue coated; teeth poor; pharynx reddened; tonsils negative. Fingers negative. Bones negative; joints negative. Thorax small and flat; circumference 83 cm. Expansion 2 cm. Glands: cervical, small; axillary, small. Depression above clavicles marked. Apical outlines narrowed, especially on right. Heart enlarged; apex, fifth space; rhythm regular; second sounds normal; murmurs, none. Pulse regular; volume fair; tension fair. Borders: Upper third rib; left, 11 cm.; right, 1½ cm. Lungs: in left chest above second rib front and spine of scapula behind, dullness, increased resistance, bronchial breathing, increased fremitus, occasional râle. In right above third rib front and angle of scapula behind, dullness, increased resistance, limited expansion, bronchial breathing, numerous râles, increased fremitus. Stage: advanced. Prognosis: doubtful. Abdomen: negative.

October 18, 1909: Patient admitted to Massachusetts General Hospital Tent Ward at 4 p.m. Appetite good.

October 19: Coughed during night occasionally without raising sputum. During day coughed several times, raising sputum. At 6.30 p.m. raised 2 dr. bright blood, also vomitus 4 dr. Twenty-four hour amount of sputum, 1½ oz. 9.30 p.m., patient coughed and raised 4 oz. bright blood, red and frothy.

October 20: After midnight patient slept five hours; coughed several times during the day. Sputum always streaked with dark blood. Twenty-four-hour amount of sputum, 6 oz.

Coughing attack at 9 p.m. Patient raised 2 dr. of blood.

October 21 : Patient continues to raise blood, dark in colour. Twenty-four-hour amount of sputum, 4 oz. Comfortable night.

Operation.—October 22 : Patient placed in dorsal position and an area prepared for operation between right nipple and anterior border of latissimus dorsi. Incision in fourth interspace over this area 1½ in. long; muscles divided, including internal intercostals. Parietal pleura exposed and found to be depressed at inspiration and not transparent. Adhesions suspected, but sharp needle introduced with great care not to injure the lung. Manometer reading showed that pleural cavity was not present. Wound then closed with through and through chromic catgut stitches. Second incision then made below and anterior to the first in region of the fifth interspace in nipple line. An opening was obtained in this place. 600 c.c. nitrogen injected. Wound closed with through and through catgut.

Physical Examination after Operation.—Heart not remarkable, not displaced. Above second rib, left front, dullness, increased resistance, increased vocal and tactile fremitus, broncho-vesicular breathing, occasional dry râles. Below second rib in right front note slightly tympanitic. Slight vocal fremitus. Tactile fremitus slightly increased above second rib. Bronchial breathing, vocal and tactile fremitus, slightly increased. Scattered coarse râles.

Subsequent History.—At 3.30 p.m. (day of operation) complained of severe pain in wound. Coughed once and raised sputum, slightly streaked with blood. Twenty-four-hour amount of sputum, 4 oz.

October 23 : Some discomfort about wound. Considerable coughing during the night. Up in chair one-half hour. X-ray taken. Has coughed less than usual and has been fairly comfortable. Twenty-four-hour amount of sputum, 5 dr.

October 24 : Slept six hours during the previous night. Less coughing during the day. No pain in wound. Faint smoky look to sputum. Twenty-four-hour amount of sputum, 6 dr.

October 25 : Uneventful night and day. Walking about. Several coughing spells in the night. Less sputum during the day. Dressing changed. Some redness about stitches.

November 1: Temperature 98° F. Pulse 106. Weight, 146¾ lb. Feels better. Cough about the same. Much less expectoration. Appetite good. Bowels fairly well. General appearance better.

November 15: Temperature 97.2° F. Pulse 118. Weight, 144¾ lb. General condition better. Side healed. Dyspnœa better. Cough and expectoration about the same. Signs on left unchanged; on right râles fewer and finer in quality; at right apex behind breathing cavernous. Few fine râles.

November 26: Temperature 97° F. Pulse 124. Weight, 143¾ lb. Cough less; increased after nitrogen injection one week ago. Very little expectoration. No pain. Appetite good.

December 6: Temperature 97° F. Pulse 130. Weight, 142½ lb. Stronger. Has good walk daily. Cough moderate, but bad in morning. Raises small amount through the day. Appetite good. Bowels regular.

December 13: Temperature 97.6° F. Pulse 108. Weight, 144¾ lb. Feels better. Cough better. Raises less. Bowels regular. Appetite good. On left, above second rib front mid-scapula behind, dullness, bronchial breathing, increased vocal and tactile fremitus, occasional fine râles in back. On right, above third rib in front angle of scapula behind, dullness, bronchial breathing, increased fremitus, scattered medium dry râles. In lower right front note tympanitic, breathing amphoric.

December 27: Temperature 97° F. Pulse 108. Weight, 146¼ lb. Was reinjected three days ago. Cough troublesome and could not keep quiet. Amount of nitrogen small. Raised a little blood afterwards. In general, cough slightly improved. Amount of expectoration about the same. Appetite good.

January 10, 1910: Temperature 97.8° F. Pulse 118. Weight, 150¾ lb.

January 14: Chest. Left border heart, fifth space; 10 cm. to left of median line. Left border, third rib. Right border 2 cm. to right. Below fourth rib in front, eighth rib behind, percussion note somewhat tympanitic. Breath sounds almost absent, but few pleural sounds heard. Above this area, breathing distant throughout lungs. Dullness increasing almost to flatness at apex. Scattered fine râles

and coarse pleural friction râles. Tactile fremitus somewhat diminished. On left, dullness above second rib front and scapular region behind. Pure bronchial breathing. No activity.

January 24: Injected four days ago. Temperature 97.2° F. Pulse 116. Weight, 148¾ lb. Below level of angle of scapula, percussion note tympanitic; breathing distinctly bronchial. Scattered coarse râles over other part of lung; breathing distinctly bronchial. Doing well.

January 31: Temperature 97° F. Pulse 110. Weight, 149½ lb. Better. Has pain in right lung and neuralgia of right eye on advent of damp weather. Has now had four nitrogen injections. Feels better afterwards. Coughs less. Raises a little in morning. Strength better. Appetite good. Bowels regular. Sleeps eight hours.

February 4: Temperature 97.8° F. Pulse 118. Weight 148¾ lb. Appetite good. Still some cough. Raises small amount. Feels stronger.

February 14: Temperature 97° F. Pulse 116. Weight, 149½ lb. Not as well for past week. Cold; hoarse. Coughs more. Appetite good. Bowels regular. Feels strong. Sleeps well. On left, signs of consolidation much less marked, few dry râles in left front. On right, signs of consolidation unchanged; râles fewer, dry quality.

February 21: Temperature 97.6° F. Pulse 140. Weight, 151 lb. Feels better. Cough improved. Cold better. Appetite good. Bowels regular. Sleeps fairly well.

February 23: Feels fairly well. Cough and expectoration improved. Hoarseness gone. Appetite good. No sweats.

March 21: Temperature 98.2° F. Pulse 112. Weight, 151¼ lb. Cough and expectoration about the same. Hoarse at times. Appetite good. Bowels regular. Raises 2 to 3 oz. daily. On right, dullness entire right side. Bronchial respiration in front; broncho-vesicular above mid-scapula. Diminished respiration below in front and with sticky, moist râles. In front, considerable fine and medium sticky, moist râles. Left lung clear. Slight dullness at apex.

April 1: Temperature 98.4° F. Pulse 108. Weight, 151¾ lb. Cough better. Raises about the same. Some dyspnœa. Has to go to work.

June 6: Temperature 99.2° F. Pulse 119. Weight, 146¾ lb. Injected with nitrogen.

April 26, 1910: Feels well. Working steadily. Sleeps out of doors. Raised a little blood one week ago.

June 24: Temperature 98° F. Pulse 84. Weight, 146¾ lb. Working steadily. Cough slightly increased. Raises 1 oz. in twenty-four hours. No blood raised. A few scattered moist medium râles.

August 16: *Physical Examination* before injection.—General condition good. Working steadily; raises about one tablespoonful daily; appetite good. Bowels regular; sleeps well. Fairly well developed and nourished. Colour good. Skin negative. Some depression above and below clavicle, more marked on right; on left, above first rib in front and mid-scapular region behind, dullness, increased resistance, increased vocal and tactile fremitus, breathing broncho-vesicular; occasional medium moist râles in lower half of left chest, mostly heard over upper part of dull area. On right, below fourth rib in front, percussion note tympanitic, breathing distant; over second rib in front and angle of scapula behind, dullness, increased resistance, limited expansion, breathing broncho-vesicular, tactile fremitus increased, scattered medium moist râles in front and through back, more at base, lung evidently considerably contracted and some air still persists in lower part of right chest. Heart not remarkable.

Area selected and cocainized between original scars of operation, and small Brauer needle inserted, but found to be bent at the point, causing difficulty in injection. This needle removed and the larger one employed. Excellent respiratory excursion of manometer when needle had been placed at a definite depth. One thousand two hundred c.c. of nitrogen injected, causing large tympanitic area over the whole lower half of the chest. Patient eager to leave the table, and went home without any discomfort, either from the needle or from the pneumothorax. Patient is now working daily.

October 22: Patient has been doing well. Examination shows only a small amount of pneumothorax persisting. Patient given an injection of 1,400 c.c. of nitrogen. Following the operation the patient immediately returned to work.

December 8: Patient has been working steadily and

doing well. Has no temperature; pulse not elevated; cough moderate. Tubercle bacilli still present in sputum. Given an injection of 1,400 c.c. of nitrogen.

March 14, 1911: Patient working steadily. General condition good. Examination shows in the right lung old signs of consolidation at the apex, but less marked than formerly. Extreme base on the right, percussion note is slightly tympanitic. The only evidence of moisture in the chest is a few scattered medium râles over the area of consolidation. An injection of 1,400 c.c. of nitrogen was given.

May 1: Patient doing well and continues at work. Cough very slight; amount of expectoration small. Will go to the country for a number of weeks.

Discussion.—In this case, although one of marked pulmonary tuberculosis, the disease has been arrested by the effect of pulmonary compression. Patient has been under observation for more than a year, and during this time he has been constantly at work since his first injection of nitrogen.

Case 6.—E. F., male.

Family History.—Mother died of tuberculosis.

Past History.—Typhoid pneumonia four or five years ago. No other sickness recalled. Went to work four years ago in a shoeshop. Two years ago a cough developed which persists. Has never had night-sweats. Has never raised any sputum.

Present Illness.—Was told of lung condition 2½ years ago. In June, 1909, entered the out-patient department of Massachusetts General Hospital, and was referred to tuberculosis class. Has been running an afternoon temperature.

Physical Examination.—Poorly developed and nourished. Colour fair. Skin negative. Few small cervical glands. Heart not enlarged. Rhythm regular; at apex forcible; no murmurs. Pulse regular, good volume and fair tension. Chest small and only fairly developed. Flattening on right chest below clavicle. Apical outline narrowed. Expansion at bases limited, especially on right. Above angle of scapula in right back and third rib front there is dullness, bronchial breathing becoming amphoric in quality at right apex behind. Resistance increased, increased vocal and tactile fremitus and scat-

tered medium moist râles. In left chest, above second rib front and level of mid-scapula behind, dullness, resistance increased; bronchial breathing and scattered coarse moist râles. Vocal fremitus diminished at left base behind; dullness, increased resistance, diminished respiration. Case one of advanced phthisis, with probably extensive pleural involvement and adhesion. Incision to be made in anterior axillary line, as lung probably tied down behind.

Operation.—October 9, 1909: Patient in semi-dorsal position semi-recumbent. One and a-half inch incision in fourth intercostal space between anterior border and latissimus dorsi and nipple. This area found to be much more suitable for injection than the dorsal areas previously selected. Few pectoral fibres divided, with no hæmorrhage. Division also of external and internal intercostals. On exposure of parietal pleura the lung was seen mobile beneath it. Pleura punctured with sharp needle. Blunt needle inserted. Considerable delay from stoppage of rubber tubing with cotton plug. Immediately upon the introduction of nitrogen the patient complained of indefinite distress in the right chest, but not of typical pleurisy pain. No change in colour of lips nor in heart action, except for a rise in rate. Wound not sutured in layers, but with deep through and through plain catgut stitches, including both intercostal layers of muscle. Small pad of gauze applied to wound with adhesive plaster. Amount of nitrogen injected, 575 c.c.

Subsequent History.—Examination, October 10, twenty-four hours following operation. Patient comfortable. Less cough and expectoration. Considerable emphysema of tissue of neck and anterior chest on right. Left lung shows less marked dullness and no resistance at base behind. Breathing at apex less bronchial and more broncho-vesicular in character. A few moist râles still present. On right, dullness, bronchial breathing and resistance above first rib in front; below tympany and absent vocal and tactile fremitus and distant breathing. Heart not displaced. Behind bronchial breathing to angle of scapula, increased vocal tactile fremitus. Scattered coarse râles present.

October 11, 12, 13, 14: Patient coughs seldom and with less difficulty. No sputum.

November 1: Patient unable to report on account of general weakness. Cough and expectoration troublesome

and somewhat increased following nitrogen injection. As he lived a considerable distance from the hospital he was unable to present himself for examination. The progress of the case was steadily downward, and he died about January 1, 1910.

Discussion.—In this instance an advanced, hopeless case was given one injection of nitrogen, but very little pulmonary compression was obtained on account of adhesions. Pneumothorax therapy was used as a last resort, without avail, as patient was unable to follow treatment.

Case 7.—F. G., male, white, single; born in Massachusetts; occupation, machinist. First appearance at Boston Consumptives' Hospital Clinic, February 3, 1908.

Family History.—Stepfather died of tuberculosis two years previous.

Past History.—Ex-Rutland patient. Attended Day Camp September, 1907, and February, 1909.

Present Illness.—Commenced in February, 1907, with hæmorrhage. Appetite good. Weight in February, 120 lb. Constipated. Troublesome cough; no night-sweats, no chills or fever. Sleeps well. Sputum positive for tubercle bacilli.

Physical Examination.—October 18, 1909: Fairly well developed and nourished.. Colour fair. Heart somewhat enlarged and pulled towards the left side. Apical outline of lungs narrowed. Expansion at bases poor. On the left side, above the third rib in front and the angle of the scapula behind, there is dullness, bronchial breathing becoming amphoric below clavicle, increased vocal and tactile fremitus and numerous medium moist râles. On the right side, above the first rib in front and the level of the mid-scapula behind, there is dullness, bronchial breathing, increased fremitus and a few medium moist râles.

October 18, 1909: Patient admitted to Massachusetts General Hospital Tent Ward.

October 19: Coughing frequently, raising sputum each time; twenty-four-hour amount, $3\frac{1}{2}$ oz.

Operation.—October 20: Patient in dorsal position with left arm raised. Skin cocainized in fifth intercostal space between anterior axillary line and nipple. Incision $1\frac{1}{4}$ in. through skin. Muscle layers cocainized and incised.

Fibres of internal intercostals divided transversely. Pleura exposed, through which lung pigment could be seen oscillating. Puncture made with sharp needle, followed by introduction of blunt needle, through which 500 c.c. of nitrogen were injected. Patient complained of no pain throughout the operation, although somewhat nervous. As nitrogen was introduced tympanitic area increased upwards above nipple line on anterior aspect of chest. Patient returned to Tent Ward in good condition. Pulse after operation of good quality; rate, 98. Complained of pain in right side of chest like pleurisy; not severe. During the day sputum raised three times. No evidence of emphysema.

October 21: Coughed twice in the night. No sputum. Appetite poor. Complains of distress in stomach. X-ray taken. Coughed several times during the day. Patient stated that raising of sputum was much less difficult. Cough looser. Patient out in steamer chair. Twenty-four-hour amount of sputum, 3 oz.

October 22: After comfortable night patient had comfortable day in steamer chair. Coughed less than on previous day. Twenty-four-hour amount of sputum, 2 oz.

Examination.—In right front, dullness and increased resistance above second rib, bronchial breathing, occasional coarse moist râles, breathing decidedly bronchial in axilla. Vocal and tactile fremitus increased in left front. Below second rib tympany, breathing distant voice-sounds almost absent, scattered dry râles in upper third of chest. Heart is displaced to right 1 in. in fourth space. In left back below level of mid-scapula note tympanitic. Scattered dry râles. Breathing practically absent, tactile fremitus absent. Pneumothorax localized in extent in lower left front, lung pushed back towards spinal column. Process seems dryer to-day.

October 23: Patient dressed and up and about. Dressing changed. Slight serous discharge at upper end of wound. Discharge relieved at 3.30 p.m. Twenty-four-hour amount of sputum, 3 oz.

Subsequent History.—November 15, 1909: Temperature 98.8° F. Pulse 126. Weight, 115 lb. Cough moderate; raises considerable in amount. Appetite fair. Examination shows on the right side, above the second rib in front and spine of scapula behind, dullness, bronchial breathing, in-

creased fremitus, and a few fine râles. On the left, above the fourth rib front and the angle of scapula behind, dullness, bronchial breathing, and numerous moist râles. Signs of cavity below clavicle, with marked retraction of chest wall.

November 19: By means of thoracentesis patient given 600 c.c. of nitrogen gas in the left pleural cavity.

December 13: Pulse 80. Weight, 116¾ lb. Cough much improved. Raises less. Less activity in chest.

December 27: Weight, 116¼ lb. General condition good. Cough improved and raises only 2 oz. in twenty-four hours.

January 10, 1910: Weight, 117½ lb. Appetite fair. Cough better. Amount of expectoration unchanged.

January 14: Left chest flat. Signs on the right side slight. On the left, above fourth rib front and angle of scapula behind, note tympanitic, breathing distant and bronchial, voice-sounds faint, coarse râles in front of chest. Evidences of cavity less marked.

January 24: Weight, 117¼ lb. Temperature normal. Pneumothorax performed four days ago on the left side, and 600 c.c. of nitrogen gas given without difficulty. Cardiac impulse seen forcibly, especially between third and fourth interspaces. Right border of heart advanced toward the right side. Below the third rib in left front and angle of scapula behind, percussion note shows good resonance, but is not tympanitic. Breath-sounds and fremitus absent over this area. Signs of consolidation marked above this area, numerous medium and coarse râles. Signs over right unchanged.

February 16: Pulse 120. Weight, 118 lb. Examination shows signs practically the same, except right chest dry and râles much fewer and dryer on left. Signs of cavity not obvious.

March 7: Pulse 118. Weight, 115½ lb. Patient has taken cold. Coughing and raising much increased. Not nearly so well.

March 28: Temperature normal. Pulse 138. Weight, 114 lb. Examination shows slight moisture in right front. On left no evidence of pneumothorax, but frequent sticky râles. Respiratory-sounds in lower left chest faint. Breathing upper left front bronchial to amphoric.

April 11: Pulse 120. Weight, 114 lb. Very little cough. Feels fairly well. Subsequent to this date the patient was unable to come to clinic on account of weakness. About the middle of June he began to have diarrhœa, which persisted in spite of treatment. Patient died July 1, 1910.

Discussion.—In this case pneumothorax therapy had very little effect on account of the advanced pulmonary process and the poor general condition of the patient.

Case 8.—A. M., female, single, age 22; occupation, none.

Family History.—Negative.

Past History.—Of no importance.

Present Illness.—Eight months ago the patient caught a severe cold, and at the end of three weeks went to bed tired and weak, with a persistent cough. After about three weeks resumed work; cough continued, and she gradually began to expectorate, until at the present time it is considerable in amount. There has been a marked loss in weight; night-sweats have been frequent, and the patient has very little strength.

Physical Examination.—November 1, 1909: Fairly well developed and nourished. Pale. No glandular enlargement. Heart area somewhat increased to right and slightly to the left. Action is regular and rapid, pulmonic second sound accentuated. No murmurs. Examination of lungs shows entire front of left chest to be dull on percussion; breathing over this area, especially in the upper half, is bronchial, and there are many high-pitched, coarse and fine moist râles; vocal fremitus is increased, tactile fremitus slightly so; on the side and left back same signs are found, but less marked. Right chest not remarkable.

Operation.—November 3, 1909: Patient placed on left side. Under cocaine a 1½ in. incision was made over the fourth rib just at the anterior axillary line, and carried down through the intercostal muscles to the pleura. The lung appeared adherent, and introduction of a needle showed no pleural cavity. The wound was then closed with catgut sutures. A similar incision was made over the seventh rib in the axillary line, with the same results; wounds healed rapidly. Patient discharged to a chronic hospital.

Discussion.—This case proved to be one that was unfavourable for artificial pneumothorax on account of the obliteration of the pleural cavity.

Case 9.—E. A. W., female, white, married, aged 39. Occupation, housework.

Family History.—Two brothers and two sisters died of tuberculosis.

Past History.—Unimportant.

Past Illness.—Took cold March, 1909. Cough developed, pain in left side, considerable expectoration, which has persisted. Examined at Boston Consumptives' Hospital, July 28, 1909, and found to be phthisis, third stage, with tubercle bacilli in the sputum. Since that time patient has been under observation at this Department, under treatment at the Mattapan Day Camp about one week during August, 1909. Has reported to the Boston Consumptives' Hospital clinic every few weeks during the past year. Has slowly gained in weight from 90 lb. to 105 lb. Condition of the chest has shown very little variation. During July, 1910, has felt very much better, cough and expectoration less and has been stronger in every way. Throat examination was negative.

July 21, 1910: Patient admitted to the Massachusetts General Tent Ward.

Physical Examination.—Fairly well developed and nourished. Colour good. Skin negative. Chest fairly well developed. Some flattening on right side. Apical outlines narrowed on both sides. Expansion at base fairly good. Heart slightly enlarged to left. Action regular, forcible, no murmurs. In right chest above second rib front and spine of scapula behind, dullness, increased resistance, limited expansion, bronchial breathing, vocal and tactile fremitus increased, occasional dry râles. On left, above first rib in front and mid-scapula region behind, dullness broncho-vesicular breathing, vocal fremitus increased, resistance increased, limited expansion, scattered moist and musical râles over dull area.

Operation.—July 22: Morphia $\frac{1}{6}$ gr. given half-hour before operation. Patient in lateral position. Left chest cleaned and an area in scapular line at level of eighth rib selected as most probably without adhesions. Incision made 2 in. long carried through skin, latissimus dorsi, and extrathoracic structures. Incision not being parallel with the rib produced a gridiron effect with the intercostal incision, which added to the difficulties. Intercostal space found to be $\frac{1}{4}$ in. wide, and being at the thick portion of the ribs presented an

insufficient area of pleura for careful observation. Lung was not seen traversing the pleural window during respiratory movements, although inspection was difficult. Large Brauer needle inserted through pleura, which caused suction of air as though into a walled-off pleural cavity. Nitrogen was administered with new apparatus. Manometer showed no oscillation when connected with chest alone, which was further proof that the cavity was not entered freely. Nitrogen seen to escape around the needle, which did not fill the pleural puncture. Including the leakage which took place, 1,200 c.c. of nitrogen were used. But as the area of tympany increased upwards and along the diaphragm it was evident that a pneumothorax had been produced, although perhaps not occasioned entirely by nitrogen. Intercostal muscles sutured together with overlying skin. Roll of gauze pressed to skin with further adhesive support to left chest. Patient complained of pain in shoulder and whole of left chest after existence of pneumothorax, pulse-rate increased, respiration sometimes rapid, but not dyspnœic.

July 24: Examination. On left, up to spine of scapula behind and clavicle in front, dull tympany present. Vocal and tactile fremitus present. Heart displaced 3 cm., to right of right sternal margin. Action regular and forcible. On right dullness less extensive, extending to clavicle in front and spine of scapula behind, breathing broncho-vesicular. Sputum, ½ oz. Coughed very little during day. Sputum is white and frothy in contrast to appearance before operation, when it was thick and yellow. No severe pain except while coughing. Slept fairly well. Two coughing spells during the night with more sputum than on previous night (1 oz.). Very little coughing during the day. Sputum, ½ oz.

July 26: Pain in breast and side (left) during the evening with cough in early morning. Slight night sweat. First dressing changed. All stitches removed; wound clean. No emphysema. Twelve-hour amount of sputum, ½ oz.

July 27: Still some soreness in region of wound. Otherwise doing well.

Subsequent History.—July 31: Four days after leaving Massachusetts General Hospital patient appeared at Burroughs Place clinic with pus in upper end of wound. Drained.

August 11: Second nitrogen injection. Cocainization satisfactory. Small Brauer needle inserted and resistance of pleura felt. 600 c.c. of nitrogen injected in anterior axillary line on level with left nipple. Patient complained of distress from pleurisy pain, due probably to adhesions put to stretch in this new locality. Examination at end of procedure showed marked tympany in axilla, extending up to the third rib in front and to the diaphragm below. Patient reports cough and sputum quantity are the same.

August 16: Dressing done; wound healed. Patient states that since last injection cough is less, though sputum is the same. Considerable evidence of pneumothorax in axillary region.

September 9: Temperature, 97° F. Pulse, 98. Weight, 109¾ lb. Cough less. Expectoration unchanged. Feels stronger and better.

September 12: Third injection, 800 c.c. of nitrogen injected.

October 20: 1,400 c.c. of nitrogen injected.

November 7: Weight, 110 lb. Cough and expectoration slight. Feels very well.

December 12: Temperature, 98. Pulse, 90. Weight, 111¼ lb. Cough slight. Raises about 1 oz. in morning. Examination shows that at right apex above second rib in front and spine of scapula behind, dullness, bronchial breathing, increased fremitus, occasional dry râles. On left dullness and bronchial breathing from above fifth rib in front, to the angle of the scapula behind. Occasional scattered moist râles. Process much drier than formerly.

December 22: Difficulty in entering pleural cavity. Nitrogen flow caused extreme pleurisy pain. 300-400 c.c. of nitrogen injected.

January 2, 1911: Cough improved. Raises about ½ oz. daily. Examination of sputum shows persistence of tubercle bacilli.

February 13: Weight, 110¾ lb. Cough slight. Raises about the same amount; feels well.

March 20: Weight, 112½ lb. Has taken some cold. Cough increased. Raises 3 oz. in twenty-four hours. Examination shows, on the right side there is slight dullness, broncho-vesicular breathing, no râles present. On the left side signs of consolidation present. Few coarse râles pre-

sent. Tubercle bacilli present in sputum. General condition excellent.

Discussion.—In this case the bilateral advanced pulmonary process has become arrested and there is very little activity.

Case 10.—M. H. W., female, white, married, aged 31. Occupation, housework.

Family History.—Two brothers and father died of tuberculosis.

Past History.—Pneumonia one year ago.

Present Illness.—Illness began one year ago following pneumonia. Not well since. Symptoms being cough, expectoration, frequently raising blood. Loss of 24 lb. in two years. General debility. Patient examined at clinic July 22, 1910, and found to be suffering with a third stage case of phthisis, involvement being extensive on the left. Temperature, 98.2° F. Pulse, 96. Weight, $120\frac{3}{4}$ lb. Pneumothorax advised.

July 26, 1910: Patient admitted to Massachusetts General Hospital Tent Ward.

Physical Examination.—Fairly well developed and nourished. Colour fair. Chest fairly well developed, considerable depression below clavicle on both sides. Heart impulse, fifth space inside nipple line. Borders apparently normal. Pulmonic second accentuated. Thrill not obtained. Pre-systolic and systolic murmur at apex, systolic ascending into axilla. Pulsation in vessels of neck. Systolic murmur over base somewhat different in quality than at apex. Cardiac râles present over precordia. Pulse regular, fair volume, low tension. Fingers show tendency to clubbing. Right chest expands more than left. Expansion at left base much limited. Above third rib, in front and region of mid-scapula behind, dullness, increased resistance, limited expansion, increased vocal and tactile fremitus, bronchial breathing, numerous fine coarse moist, and musical râles throughout dull area, more marked in front. On right, above first rib in front and 1 mm. below spine of scapula behind, dullness, increased resistance, increased vocal and tactile fremitus, bronchial breathing, occasional dry râle over dull area and lower part of chest, process on left much more extensive and active. About six months pregnant.

July 27 : Twenty-four-hour amount of sputum, which is well streaked with blood, 5 oz.

July 28 : Twenty-four-hour amount of sputum, slightly tinged with blood, 6½ oz.

Operation.—July 29 : Incision 2 in. long under cocaine anæsthesia in left posterior axillary line, through muscles down to intercostal layer. Latter incised for 1 in. and pleura exposed. No pain throughout this procedure. But patient vomited once and was nervous. Possible that nausea was due to morphia given before operation. Lung was not freely mobile beneath the pleura. Needle inserted at an angle dissecting along between the pleural layers. Nitrogen flowed with considerable ease, and manometer showed a respiratory excursion. Amount of nitrogen injected into pleural cavity, 1,100 c.c.

Examination after Operation.—Dullness on right modified from intense quality, breathing, instead of bronchial more broncho-vesicular. On left, dullness modified in front as far as clavicle, there being good resonance behind up to spine of scapula ; breathing distant ; râles fewer.

Returned from operation in good condition ; pulse, respiration and temperature remain at normal. Complaint of soreness in back, where small area of emphysema in mid-region of wound is made out. No coughing. Twenty-four hour amount of sputum, 7 dr.

Subsequent History.—July 30 : Patient coughed and expectorated freely without blood. Emphysematous area diminished. At night coughed more than previous night and complained of soreness on moving. Sputum very bloody. Twenty-four-hour amount, 3½ oz.

July 31 : A little more coughing this morning than usual, with blood-stained sputum. Coughed a great deal from 12 to 3.30 a.m. Sputum bright red. Twenty-four-hour amount, 4 oz.

August 1 : Stitches removed ; wound apparently clean. Slight coughing, but sputum still blood streaked. Twenty-four-hour amount of sputum, 1½ oz.

August 16 : Temperature, 98° F. Weight, 125 lb. Cough considerable. Less expectoration. No pain or sweats. Examination shows at right apex signs of consolidation with an occasional musical râle. On left, consolidation over upper third, scattered musical râles.

August 30: Apparent evidence of some persisting pneumothorax in region of original incision below which a long needle was inserted with novocain. Subsequent introduction of Brauer needle was not as simple as in most cases, and it seemed to meet obstructions beneath the pleura as though adhesions were present. It was with some difficulty that the manometer was made to oscillate, at which point the needle was held firmly while 1,000 c.c. of nitrogen were injected. On two occasions removal of the needle was necessary in order to evacuate some blood-stained tissue. Patient's condition is apparently much improved, with less cough and less sputum, and greater facility in breathing.

October 19: Weight, 129 lb. Feels well. Cough improved. Raises 1 oz. in twenty-four hours. Doing well. General condition good. Considerable flattening in front of chest, more marked on left. Marked retraction of left apex. Very little evidence of activity.

February 6, 1911: Patient confined in November. Has not been so well since. Cough and expectoration increased. Examination shows that the process at the left apex is active, no activity on right.

March 14: General condition fair. Pneumothorax performed and 1,300 c.c. of nitrogen injected. Very little change in physical signs from last examination.

June 21: Patient has been doing very well. Cough is slight; there is very little expectoration, and she has been caring for her household. There is some loss in weight, it being at present 117½ lb. Examination shows general condition fairly good. There is marked retraction of both apices, especially on the left side below the clavicle. On the right side, old signs of consolidation persist. There is no activity. On the left, below the clavicle and extending into the axilla, there is evidence of cavity formation with the heart being pulled over into it. Above this level, and over the upper half of lung at back, there are marked signs of consolidation with scattered fine râles. The process is much less active than previously.

Discussion.—In this case we feel that pneumothorax therapy has been of material benefit. While the disease is by no means cured, nevertheless, the active process on the right has become entirely quiescent and there is markd evidence of healing in the left side. She has, furthermore, gone through the real peril of a pregnancy well.

Case 11.—H. F., female, white, aged 15. Occupation, school.

Family History.—Unimportant.

Past History.—Unimportant.

Present Illness.—About six months ago, following a heavy cold, patient developed bronchitis, which has persisted. Has been slowly losing weight. Raised some blood about three months ago, but none since. Cough at present troublesome. Amount of expectoration small. Has been under observation at the Good Samaritan Day Camp about four months, and in spite of hygienic treatment has lost ground. Has had irregular temperature, and the process in her chest is slowly extending.

July 30, 1910: Feels well; raises about 2 oz. daily; cough slight; sleeps well. Appetite good; no chest pains or night sweats.

Physical Examination.—Fairly well developed and nourished. Colour good. Chest small, flattened on right. Expansion at right base limited. On right, above second rib in front, 2 mm. below spine of scapula behind, dullness, increased resistance, bronchial breathing, increased vocal and tactile fremitus, distant medium dry râles, respiration harsh in right front. On left, expansion markedly limited. Dullness practically throughout left chest, more marked at apex, resistance increased, especially behind apex. At left apex, scattered medium and musical râles. Throughout chest process extensive, not so active.

August 24: Coughs a little, but feels well. Flattening of left chest below clavicle. Dullness and increased resistance from apex to base, with increased vocal and tactile fremitus and numerous coarse, moist, and gurgling râles throughout. Dullness and increased resistance at right apex and an occasional medium musical râle. Small expansion at both bases.

September 7: Pneumothorax treatment decided upon to check pulmonary process. By means of the Brauer method, 1,200 c.c. nitrogen were injected into the left anterior axillary line.

Subsequent History.—October 4: Patient re-inoculated by means of thoracentesis in left axilla, receiving 1,000 c.c. of nitrogen.

October 20: Appears somewhat better, cough improving,

raising 1½ oz. daily. Fairly well developed and nourished. Chest fairly well developed; at right apex slight signs of consolidation, occasional scattered râle. On left scattered moist râles. Throughout evidence of consolidation fairly well marked. Lower half of lung respiratory sounds and fremitus diminished, still some pneumothorax present; some improvement.

November 17: Patient shows material improvement since receiving nitrogen gas. Temperature has been lowered and there seems to be less activity in the chest. By means of thoracentesis, 1,000 c.c. of nitrogen were injected in the left axilla, as previously, without discomfort.

November 28: Very little cough. Small amount of expectoration. Feels well. Examination: Left apex down to second rib gives a tympanitic note on percussion; below this there is dullness down to base. Back dull from top of scapula to base. Bronchial breathing at apex with few scattered moist râles. At mid-scapula distant high-pitched bronchial breathing. Breath sound faint in whole lower part of left chest. At base, behind, numerous moist râles. Right apex shows slight dullness, occasional scattered râle.

January 12, 1911: Patient steadily improving. Has gained in weight. Cough and expectoration slight. Examination shows cessation of activity on right side. On the left side there is amphoric breathing in middle of back over an area about 2 in. in diameter. Over the area of consolidation, numerous moist râles are still present.

January 27: Patient has taken cold and will not properly carry out treatment. Running temperature at night; coughing considerable. Slight pain in left chest, as at last note. Process extending in right chest, dullness and increased fremitus down to mid-scapula behind and to third rib in front. Few medium râles.

March 14: Patient has failed to gain in the last month. Has taken a second cold and following this has been running a slight evening temperature. Cough, however, is very slight and there is practically no expectoration. Examination shows the presence of pneumothorax at the left base behind. Scattered throughout both chests are musical râles. Some evidence of lung retraction over the left upper lobe. Thoracentesis was performed and the patient given 1,400 c.c. nitrogen without discomfort.

May 1: Patient under observation constantly. Cough very slight, expectoration about ½ oz. in twenty-four hours. Tubercle bacilli still present in sputum. Examination shows a quiescent process in right chest and very little evidence of activity in the left.

Discussion.—In this case, while at present pulmonary disease has been brought to a standstill, on account of the ignorance and carelessness of the patient, the prognosis is poor. We feel, however, that the value of pneumothorax therapy in lessening symptoms and aiding in checking pulmonary disease at least temporarily has been strikingly shown in this case.

Case 12.—F. J. P., male, white, aged 15. At school.

Family History.—Negative.

Past History.—Negative.

Present Illness.—July 22, 1910: Reported to clinic of Boston Consumptives' Hospital. Gave history of cough, considerable expectoration, also of having raised blood on March 10, 1910. Examination showed active phthisis. Temperature, 100.2° F.; pulse, 90; weight, 134 lb. Tubercle bacilli in sputum. Pneumothorax advised.

August 1: Patient admitted to Massachusetts General Hospital Tent Ward. No sputum. No temperature. Slept all night with very little coughing and no sputum.

Physical Examination.—Fairly well developed and nourished. Colour good. Chest well developed; some flattening on both sides. Left chest moves more than right. Heart borders normal, action regular, forcible, impulse heaving. Pulmonic second accentuated, slightly systolic at apex, partly replacing first sound. Pulse excellent. Apical outline narrow on right. Expansion at right base fair. Above angle of scapula on right, behind, and to second rib in front, dullness, increased resistance, slightly increased tactile fremitus, vocal fremitus increased at apex, numerous fine and dry râles. On left, expansion at base fair. Apical outline narrow. Above clavicle in front, spine of scapula behind, dullness increased resistance, broncho-vesicular breathing, tactile fremitus diminished, occasional fine râles, resonance at left base poor, breathing only fair.

Operation.—August 3: Patient in dorsal position. Right chest exposed, tympanitic area directly beneath the right

nipple selected as favourable for injection under cocaine anæsthesia. Skin, subcutaneous tissue, and pectoral muscles divided, intercostal fibres separated and divided, and pleura exposed in the usual way for distance of 1 cm., through which dotted pigmentation could readily be seen passing under the pleura. Cocaine anæsthesia entirely satisfactory. Brauer needle inserted and connected with manometer. No respiratory excursion. Needle withdrawn and re-inserted at more acute angle to avoid lung, after which respiratory excursion was seen in manometer, and nitrogen flowed readily. Flow of nitrogen checked with valve to cause more gradual lung collapse. Patient perspired freely. Experienced no pleurisy pains. Nitrogen omitted after injection of 1,200 c.c., although greater quantity could undoubtedly have been inserted. Intercostal gauze roll applied with adhesive. Patient returned from operation at 11 a.m. in good condition, some soreness in side after absorption of cocaine. Slight elevation of temperature; no cough or sputum. Very slight emphysema in region of axilla.

Subsequent History.—August 4: Patient up all day; no coughing or sputum; appetite good. Coughed more than usual at night. Not much sputum.

August 5: Up all day; no emphysema. No coughing or sputum. Stitches left in wound.

August 16: No cough, no raising; patient feels very well. No night sweats, appetite good, sleeps well. Examination shows lung on right still expanded in back, breathing somewhat distant in front; below third rib note tympanitic.

August 25: General condition good. No coughing, no expectoration since leaving Tent Ward. Examination shows, below third rib on front, 1 in. above angle of scapula behind, resonance bordering on tympany, with diminished respiratory and vocal sounds. No râles. Patient inoculated with 1,300 c.c. of nitrogen at fourth intercostal space. Patient's general condition has improved. Cough and sputum have been practically absent. Physical examination shows evidence of small persisting pneumothorax. Cocaine anæsthesia complete (½ per cent. cocaine). In immediate region of first incision large Brauer needle inserted perpendicularly, which unquestionably entered an empty

pleural cavity, 1,300 c.c. nitrogen injected without causing the slightest distress or symptoms.

September 7: Temperature, 98° F. Pulse, 96. Weight, 139½ lb. Feeling well. Less cough. No expectoration. Appetite good. Examination: No signs at left apex. On right modified dullness, fremitus increased. Occasional dry râles. Pneumothorax at base.

September 21: Temperature, 99.4° F. Pulse, 104. Weight, 137¾ lb. Has a cold; cough severe; appetite good; bowels regular. No pain. Raises considerably.

October 3: Temperature, 97.6° F. Pulse, 82. Weight, 137½ lb. Has raised small amount of blood. Cough moderate. Appetite poor.

October 8: Temperature, 97.4° F. Pulse, 102. Weight, 139¾ lb. Doing well. Inoculated with 1,350 c.c. of nitrogen.

October 19: Temperature, 99° F. Pulse, 100. Weight, 138½ lb. No bad results from pneumothorax. Cough improved. No blood. Raises ½ dr. in twenty-four hours. No pain; no sweats.

October 26: Temperature, 97° F. Pulse, 92. Weight, 141 lb. Feels well. Appetite fair. Cough almost gone. Raises very little. Sleeps well.

November 11: Temperature, 98.4° F. Pulse, 112. Weight, 144½ lb. Feels well. Cough almost gone. Raises very little. Sleeps well.

November 11: Examination. Well developed and nourished. Colour good. Chest flat. Heart action rapid and forcible. Pulmonic second accentuated. Left chest above first rib in front, dullness, increased resistance; voice sounds not increased; occasional medium dry râle. Lower half of right chest gives almost tympanitic note with much diminished voice sounds. Above this area dullness; bronchial breathing; increased vocal and tactile fremitus; few dry râles.

November 21: Temperature, 97.2° F. Pulse, 84. Weight, 147¾ lb. Feels well. Cough almost gone. Coughs once or twice daily. Very small amount raised.

December 2: Temperature, 97.6° F. Pulse, 112. Weight, 147¾ lb. No cough; slightly more expectoration. Appetite good. Doing well.

December 9: Temperature, 98.6° F. Pulse, 112. Weight, 146½ lb. Cough moderate. Raises 1 dr. daily.

January 4, 1911: Temperature, 97° F. Pulse, 100. Weight, 144 lb. Has felt well. Appetite good. No pains or sweats. No cough. No expectoration.

January 13: Temperature, 99.4° F. Pulse, 78. Weight, 144½ lb. Feeling well. Cough slight. Raises a little. Appetite good. Bowels regular. At the left apex, above secind rib, dullness, broncho-vesicular respiration. Some fine moist râles with cough. Few râles with cough at left apex front. Dullness and broncho-vesicular respiration in front. Diminished respiration in back. Some fine and moist sticky râles first and second interspaces. Few above clavicle and to mid-scapula in back. Stretching sounds in lower half.

January 18: Temperature, 97° F. Pulse, 100. Weight, 144½ lb. Appetite good. Cough increased following cold. Raises moderate amount.

January 25: Temperature, 97.8° F. Pulse, 104. Weight, 146¼ lb. Condition better.

February 8: Temperature, 97.8° F. Pulse, 120. Weight, 148¼ lb. Feels well. Slight cough.

February 15: Temperature, 97° F. Pulse, 84. Weight, 149 lb. Cough nearly gone. On left, above first rib front and spine of scapula behind, dullness, bronchial respiration. Numerous fine and medium moist râles with cough. On right, above third rib front and mid-scapula behind, dullness, broncho-vesicular respiration. Considerable moist and coarse râles with cough to third interspace. Some fine râles with cough in back.

March 1: Temperature, 97.4° F. Pulse, 84. Weight, 149 lb. Feels well. Cough moderate. Took cold four days ago. Raises nothing. Appetite good.

March 17: Temperature, 97.6° F. Pulse, 98. Weight, 148¼ lb. General condition good. Raises ½ dr. in twenty-four hours. Appetite good. Bowels regular. Cough moderate.

March 22: Temperature, 97° F. Pulse, 96. Weight, 146¾ lb. Cough practically gone. Raises about ½ dr. in twenty-four hours.

April 1: General condition good. Process on left arrested. The right lung, following the absorption of nitrogen, has re-expanded. Examination of the sputum still shows tubercle bacilli present.

Discussion.—This case has been one in which the disease has been arrested and the general condition much improved.

Case 13.—D. J. D., male, white, single, aged 54; birthplace, Ireland; occupation, labourer.

Family History.—Negative.

Past History.—Negative.

Past Illness.—Alcohol excessive. Patient first reported to Boston Consumptives Hospital clinic on February 17, 1908. Considered practically negative case, although having some cough and expectoration at that time and loss of weight. Sputum was negative. Since that day patient reported occasionally for examination.

March 7, 1910: Running slight temperature. Pulse, 100. Weight, 130¼ lb. July 8, 1910: Weight, 111¼ lb. Had been knocking about town. Extensive signs throughout right, especially at base. Kept under observation for several weeks, then referred for hospital treatment.

Physical Examination.—August 2, 1910: Fairly well developed and nourished. Colour fair. Skin negative. Chest only fairly developed. Lower right chest more prominent than left, and broader. Left border of heart, nipple line. Right border 1 cm. to right of sternum. Rhythm regular and forcible. Pulmonic second accentuated, no murmurs. Pulse regular, good volume, good tension. Artery wall palpable. Apical outline narrow on both sides, more marked on right. Expansion poor on left, none on right. On left, above clavicle in front and area of mid-scapula behind, dullness, increased resistance, increased vocal fremitus, breathing broncho-vesicular; no râles heard, except those transmitted. On right, dullness throughout back and to second rib in front, increased resistance, more marked at apex than base. Medium and coarse moist râles at apex, extending well down back into base, bronchial breathing at apex, becoming broncho-vesicular at mid-back and diminished at base, vocal and tactile fremitus somewhat increased, beginning at mid-chest.

Operation.—Cocaine anæsthesia. Patient in dorsal position, right chest exposed, tympanitic area directly beneath right nipple selected as favourable for injection under cocaine anæsthesia. Skin, subcutaneous tissue and pectoral muscle divided; intercostal fibres separated and divided and pleura

exposed, through which lung pigmentation could be seen crossing the field. Brauer needle inserted at acute angle and connected with manometer, which showed definite respiratory excursion. Nitrogen 1,200 c.c. injected without causing the slightest discomfort or symptom, except, perhaps, a slight increase in respiration and pulse. No displacement of the heart made out on percussion. Intercostal fibres sutured with 00 plain catgut; pectoral muscle and fascia sutured in a second layer interrupted s.w.g to skin. Lemke rolled dressing applied with adhesive.

Physical Examination after Operation.—In right chest good resonance of tympanitic quality up to clavicle in front and angle of scapula behind, râles have entirely disappeared, breathing bronchial in back, practically absent below angle of scapula and over front of chest. Fremitus practically gone in front. Left border of heart displaced 1 in. to left. Percussion note improved in left back, breathing broncho-vesicular.

Patient returned to ward in good condition after operation; some soreness in side; coughed only occasionally; raises no sputum; quite comfortable.

Subsequent History.—August 3: Patient's temperature has risen steadily, but he says he feels very well. Very small area of emphysema and very little soreness in wound. Diarrhœa has subsided. Vomited after eating dinner. Temperature, 102.4° F. Only occasional cough. No sputum. Night comfortable; little cough, no sputum.

August 4: Patient says he feels perfectly well. Temperature, 103.4° F. Has vomited twice to-day. Dressing done. Wound clean. No emphysema. No sputum.

August 5: Temperature dropped to-day; very slight serous discharge from wound. No emphysema; only occasional cough; no sputum. Pulse not as good as it has been. Twenty-four-hour amount of sputum, 2 oz.

August 6: Temperature, 103° F. X-ray taken this afternoon. Dressing done; wound discharging in one corner. Twenty-four-hour amount of sputum, 3 oz.

August 8: Out of bed all day, and did not cough at all. Less coughing at night than previous night. Slept well. Twenty-four-hour amount of sputum, 2 oz.

August 10: Dressing changed. Wound discharging freely. Coughed and raised some sputum during the day. Twenty-four-hour amount of sputum, 4 oz.

August 26: Temperature, 98.6° F. Pulse, 120. Weight, 110½ lb. General condition poor. Patient coughing and raising a good deal.

September 7: Temperature, 98.7° F. Pulse, 90. Weight, 111½ lb. Examination shows signs at left apex much less marked. Percussion note improved. Breathing broncho-vesicular. On right, signs of consolidation over upper lobe marked; scattered medium dry râles in this area.

September 14: 1,200 c.c. of nitrogen injected. Cough and expectoration before operation troublesome. Amount of sputum raised, about 3 oz.

September 21: Temperature, 98.2° F. Pulse, 100. Weight, 114 lb. Cough and expectoration apparently increased following the nitrogen injection.

October 10: Temperature, 97° F. Pulse, 84. Weight, 119½ lb. Patient does not follow hygienic treatment. Drinks heavily.

November 9: Temperature, 97° F. Pulse, 88. Weight, 115¾ lb. Patient's condition not good. Examination shows some evidence of activity at left apex. On right at apex signs of consolidation present. Few medium râles present. Lung has re-expanded. Pleural râles present at right base. Patient shortly sent into the Consumptives Hospital, as he was an unfavourable case for further treatment as regards surroundings and habits.

Discussion.—The effect of artificial pneumothorax in this case was even more noticeable than is shown in the record. In spite of the poorest home surroundings and habits, the patient improved remarkably in his general condition, and the process in his lungs was brought to a standstill. Had there been opportunity to follow treatment consistently, the outcome would undoubtedly have been favourable.

Case 14.—M. K., male, white, married, aged 39; born in Russia; occupation, blacksmith.

Family History.—Mother died of tuberculosis.

Past History.—Negative.

Present Illness.—Reported to Boston Consumptives Hospital clinic on January 21, 1910, giving the following history:—Two months ago took severe cold, which has persisted since. Coughing; hoarse; raised some blood; some pain in the chest. Weight, 133 lb. Temperature, 98.6° F.

Pulse, 60. Examination shows nothing remarkable in heart. Active process at angle of right scapula. Patient sent to Day Camp for treatment. Was discharged from Day Camp March 12, and went to Lakeville. Reported at this clinic April 27, 1910, having returned from Lakeville. Examination at that time shows an active process, involving upper lobe and a half on right. Temperature, 99.4° F. Pulse, 122. Weight, 129 lb.

August 15, 1910: Patient admitted to Massachusetts General Hospital Tent Ward. Coughs frequently, but does not raise much sputum. Prepared for operation, both sides of chest from sternum to spine. Twenty-four-hour amount of sputum, 6½ oz.

Physical Examination.—August 16: Well developed and nourished. Colour fair. Skin negative. Fingers clubbed. Chest, barrel-shaped, broad; depression below clavicle on right. Heart slightly enlarged to left. Right border not displaced. Sounds regular, fair quality. Second sound accentuated. Rhythm rapid, forcible. Pulse: Fair volume, regular, low tension. Apices: Outlines narrow on both sides; expansion at bases is limited on both sides. Right chest, above second rib in front and mid-scapula behind, there is dullness, limited expansion, increased resistance, increased vocal and tactile fremitus. Scattered medium moist râles. Breathing bronchial, except at spine of scapula behind, where breathing is almost amphoric. On left, above clavicle in front, spine of scapula behind, dullness and increased resistance. Broncho-vesicular breathing. Occasional dry râles.

Operation.—Incision (under cocaine anæsthesia) 2 in. directly below right nipple over a tympanitic area. Fat divided, pectoral muscles separated and not divided, making a deep wound and very inconvenient and inaccessible. Intercostal muscles divided and pleura exposed, but not clearly on account of slight hæmorrhage. Needle inserted at right angles with opening which allowed some leakage around it. Nitrogen 1,000 c.c. injected; manometer excursion satisfactory. At end of injection patient complained of some pain in right chest low in the region of the diaphragm. Emphysema noted over whole pectoral region two hours after operation.

Physical Examination after Operation.—Below clavicle

in front and angle of scapula behind percussion note tympanitic, breathing distant, râles absent; heart slightly displaced to left.

Patient complains of pleurisy pain in chest. Adhesive strapping reinforced. Emphysema present in right chest. Patient had several short naps this afternoon, and coughed very little. Condition good all night. Twenty-four-hour amount of sputum, 1 oz.

August 17: Had several attacks of coughing, which caused pain in chest. Codeia gave relief. Twenty-four-hour amount of sputum, 2½ oz.

August 18: Some coughing in the morning. Pleurisy pain still persists, but less severe than yesterday. Emphysema lessening in right chest. Wound dressed and found to be absolutely clean. Some dyspnœa since operation. Fingers and lips slightly blue. Heart 2½ cm. outside of nipple line. Action regular, forcible. Pulse regular, fair volume, low tension. Good resonance over entire right front, with very little resistance to percussion. Breathing distant, tactile and vocal fremitus almost absent. Few scattered medium moist râles in right front. Breathing distant, bronchial in back on right. Tactile fremitus almost absent, except at base, where breathing is nearly normal. Lung collapsed above, held down at base behind by adhesions. Breathing in left chest much diminished in front, broncho-vesicular breathing behind.

August 18: Discharged relieved to out-patient department.

Subsequent History.—August 19: Returned to out-patient department for X-ray. Emphysema over front of right chest. Patient came to hospital with great difficulty, and was somewhat dyspnœic and pale on arrival. States that he becomes very short of breath at night.

August 22: Two days after last appearance emphysema very much diminished. Wound clean; continuous stitch removed. Patient only complaining of shortness of breath, which is less marked.

August 30: Expectoration diminished one-half since last injection. On left, signs of consolidation less marked. Râles few and more distant, most numerous below clavicle on left. On right, pneumothorax present below fourth rib in front, and angle of scapula behind; fremitus slight;

breathing distant. Breathing at apex pure bronchial. Occasional coarse râles in back. Nitrogen injected; puncture method employed without pain. Needle distinctly entered the pleural cavity, into which 1,200 c.c. of nitrogen were injected, without causing symptoms or change in condition.

September 10: Temperature, 97.8° F. Pulse, 120. Weight, 123 lb. Had pneumothorax 1½ weeks ago; reinjected one week ago. Cough troublesome. Raises a great deal—six cups daily (?).

October 14: Temperature, 99° F. Pulse, 92. Weight, 124 lb. Feeling poorly. Coughing and raising a great deal.

October 20: 1,300 c.c. of nitrogen injected.

January 6, 1911: Weight, 124¾ lb. Feeling fairly well; no pains; moderate cough.

February 5: Weight, 124 lb. Examination shows general condition poor. Scattered râles over both lungs; signs of consolidation over both apices.

February 6: Weight, 126½ lb. Cough troublesome, frequently vomiting after spell. Expectoration about 2 to 3 oz. General condition good. Examination shows on left dullness above second rib in front and scapula behind. Broncho-vesicular respiration, scattered coarse moist râles. In right chest, above fourth rib in front mid-scapular region behind, dullness and resistance, broncho-vesicular respiration, scattered moist râles. Harsh respiration in lower left chest.

March 25: Since last report patient has had cold, running a temperature, and has gone down-hill. Heart action poor, breathing difficult. Three days ago began to show meningeal symptoms, with a retracted head and semi-unconsciousness. Examination shows râles throughout chest. Signs of consolidation at apices unchanged. Lower right, front breathing distant, resonance good. Patient lived two days. Autopsy refused.

Discussion.—This case was an advanced bilateral one of phthisis, and, unfavourable at the outset, was not benefited by pulmonary compression.

Case 15.—M. J. K., female, white, married, aged 44. Born in Canada. Occupation, housewife.

Family History.—Unimportant.

Past History.—Unimportant.

Present Illness.—Patient has been under observation at the Boston Consumptives Hospital since May 7, 1909. For the past eight months has been troubled with cough and expectoration, which have been persistent. During this time she has had chills and night sweats and occasional pains in the chest. She has lost 18 lb. in weight. Her first examination showed an active pulmonary process of moderate extent on the right, and slight on the left. Tubercle bacilli were present in the sputum. There has been a gradual increase in signs until on July 27, 1910, the pulmonary process was found to include two upper lobes on the right and the upper lobe on the left with considerable evidence of activity. On August 18, 1910, patient was admitted to the Massachusetts General Hospital Tent Ward for treatment with artificial pneumothorax. The measured twenty-four-hour amount of sputum amounted to 1½ oz.

Physical Examination.—Well developed and nourished. Colour fair. Chest flat, fairly well developed, with some depression above and below the clavicles, more marked on the right side. Heart is enlarged to the left. Pulmonic second is accentuated. The action is regular and forcible. Apical outlines narrow on both sides. Expansion at base of lung fairly good. Above the third rib, in the right front, and the angle of scapula in back there is dullness, increased resistance, bronchial breathing, increased vocal and tactile fremitus and scattered fine and coarse dry râles. Breathing is markedly bronchial at the apex, where the lung is considerably retracted. On the left side, above the second rib in front and the level of mid-scapula behind, there is dullness, increased resistance, bronchial breathing, increased vocal and tactile fremitus and a few dry râles.

Operation.—August 19: Novocain anæsthesia. Owing to apparent toxic absorption from cocaine used in previous operations, novocain was used in tablet form. Point selected high in axilla, between anterior axillary line and border of right breast. Two and a half inch incision dividing skin, fat and edge of pectoral muscle. Intercostals separated and divided and pleura exposed, through which lung tissue could be seen oscillating. Sharp Brauer needle inserted and 1,300 c.c. of nitrogen injected without causing symptoms and apparently without leakage, although gas was received

slowly. No pallor of face, or high pulse, or sweating, or other symptoms of cocaine absorption. Following the operation there was some pleurisy pain; no emphysema developed: cough was somewhat increased, but the measured twenty-four-hour amount sputum was only 1 oz.

Subsequent History.—August 21: Wound clean; little, if any, emphysema; cough and expectoration diminished.

August 22: Expectoration slightly increased, twenty-four-hour amount 2½ oz.

September 12: Patient reported for nitrogen treatment. Has improved somewhat since first injection. Cough has been slight, expectoration has slowly diminished. Has gained about 2 lb. in weight. Thoracentesis attempted, but on account of pain and poor mental condition of patient it was a failure. Since this date patient has refused further treatment, and on account of moving away has been lost sight of.

Discussion.—This case was one of advanced bilateral phthisis in which, with prolonged nitrogen treatment, the bad prognosis might have been modified, especially as the lung most extensively involved was still collapsible.

Case 16.—E. M., female, white, single, aged 25. Occupation, housework.

Family History.—Negative.

Past History.—Negative.

Present Illness.—First examination August 4, 1909. Following history obtained for one year. Debility with cough. Some streaked sputum raised at times; chills for one week; loss of 9 lb. in one year. Some pain in chest. Examination showed second stage of phthisis involving two upper lobes of left lung. Slight signs also at right apex. After this date patient moved out of town and was not seen again until August, 1910. Examination showed signs in right lung unchanged. Process on left more extensive, involvement being complete from and extending well down to mid-scapular region behind.

August 18, 1910: Patient admitted to Massachusetts General Hospital Tent Ward. Eighteen-hour amount of sputum, 2 dr.

August 19: Very little coughing. Twenty-four-hour amount of sputum, 3 oz.

August 20: X-ray of chest taken. Some coughing.
August 22: Twenty-four-hour amount of sputum, 6 dr.
August 24: X-ray plates show bilateral involvement, although physical examination implies that right chest is not active. Plate would seem to indicate that lower left lobe was not involved, and perhaps not adherent.

Physical Examination.—Well developed and nourished. Colour fair. Skin negative. Chest poorly developed, hollow below and above clavicle, more on right. Heart. Apex, fifth rib, intercostal space. Action regular, forcible. Pulmonic second accentuated. No murmurs. Expansion at right base behind limited, absent on left. Above first rib, front, angle of scapula behind, is an area of dullness; distant bronchial breathing, increased resistance, slightly increased vocal and tactile fremitus, few medium dry râles. Above third rib, left front, and angle of scapula behind, area of dullness, increased resistance, increased vocal and tactile fremitus, scattered coarse râles. Below angle of scapula behind, some dullness, limited expansion, broncho-vesicular breathing, occasional scattered râles. Percussion note suggests loss of lung tissue below left clavicle.

Operation.—August 24: Novocain and adrenalin anæsthesia. First area selected in fifth space anterior axillary line. Anæsthesia satisfactory. Pleura exposed, through which, though whitish in colour and not of abnormal transparency, a movement beneath it could seem to be detected. Introduction of needle caused some pain, but the former did not enter a space and manometer reading proved that adhesions were present. Nitrogen could not be injected. This area abandoned and sutured. Second area selected in scapular line in the region of the ninth interspace; pleura again found somewhat thickened and the pleural cavity was not entered by the needle. Nitrogen again failed to enter. On basis of two negative incisions, procedure was abandoned and patient sent to the ward.

Subsequent History.—August 24: Patient returned from operation having severe pain. Relieved by morphia, after which patient slept in naps. Twenty-four-hour amount of sputum, 7 dr.

August 25: Patient complained of severe headache. Iced alcohol compresses applied to forehead with some relief. Twenty-four-hour amount of sputum, 1 oz.

August 26: Patient still suffering from headache. Twenty-four-hour amount of sputum, $2\frac{1}{2}$ oz.

August 27: Patient complained of headache and pain in side. Twenty-four-hour amount of sputum, $3\frac{1}{2}$ oz.

August 29: Patient feels stronger and more comfortable to-day. Stitches removed. Twenty-four-hour amount of sputum, $3\frac{1}{2}$ oz.

August 30: Patient feels comfortable this morning.

Discussion.—In this case, on account of the adhesions of the pleural surface, it was impossible to produce a pneumothorax and with it lung collapse. Had this been possible this case would have been one eminently suited to pneumothorax therapy.

Case 17.—R. F. C., female, coloured, single, aged 22. Occupation, seamstress.

Family History.—Negative.

Past History.—Negative.

Present Illness.—Patient gave the following history: Cough, cold, and some expectoration for five weeks; lost 15 lb.; some night sweats; poor appetite. Examination showed an advanced case of phthisis with cavity formation involving the upper two lobes on the left. Some fluid at left base. Tubercle bacilli in sputum. Patient has been followed through the clinic of the Boston Consumptives' Hospital. Had been under treatment at St. Monica's Home. Signs on left chest unchanged, except absence of fluid at base. Some involvement at right apex, but not extensive. General condition poor.

August 25, 1910: Admitted to Massachusetts General Tent Ward. Twenty-four-hour amount of sputum, 2 dr. X-ray of chest taken.

Physical Examination.—August 26: Poorly developed nourished. Colour fair. Skin negative. Chest poorly developed. Sternum prominent above, depressed below. Heart slightly enlarged to left. Action regular, forcible, pulmonic second accentuated. Heart drawn slightly upward. Apical outlines narrowed on both sides. Expansion at bases limited. On right above first rib, front, spine of scapula behind, dullness increased resistance, limited expansion. Bronchial breathing, increased vocal and tactile fremitus. Occasional fine and medium dry râles. Breathing in

left, front, down to second rib, harsh and variable. On left throughout front and above angle of scapula behind, dullness, increased resistance, limited expansion. Bronchial breathing, except in left front, where breathing is cavernous. Scattered medium and coarse moist râles.

Operation.—Novocain and adrenalin anæsthesia. Patient in semi-lateral position. Area selected lower than any other case to date, to wit, in the left eighth intercostal space in the posterior axillary line. Anæsthesia complete, pleura exposed and found thin and transparent, without adhesions. Needle inserted and 1,200 c.c. of nitrogen injected, causing no discomfort or symptoms on part of patient. Immediately concurrent with suturing of intercostal muscles, patient became pale and complained of heavy feeling in the chest. Pulse slow and of fair volume [60]. Another attempt at suturing interrupted by faintness expressed by the patient. Strychnia, with change of position, caused some relief; however, condition was in a sense alarming. During completion of suture patient complained only of shortness of breath. Respirations were increased, but not dyspnœic. Soon after operation patient expectorated a rather large accumulation of pus, which she remarked was of foul taste and unusual quantity.

X-ray taken morning of operation shows bilateral involvement of upper half of each chest, with greater opacity on the left. Plate showed that process on right was nearer the posterior wall.

Patient returned to ward after operation feeling rather faint. Revived after eating and took several short naps in the afternoon. Some coughing. At night complained of pain in side when she breathed. Had very little cough. Twenty-four-hour amount of sputum, 3 oz.

Subsequent History.—August 27: Up in chair; side quite lame, but does not complain of pleurisy pain. No emphysema. At night patient complained of shortness of breath. Slept about seven hours; coughed a good deal when awake. Twenty-four-hour amount of sputum, 6 oz.

August 28: Patient has very little pain in side to-day; had some short naps in the morning, and sat up in chair in the afternoon. Twenty-four-hour amount of sputum, $3\frac{1}{2}$ oz.

August 29: Patient very comfortable this morning. No

emphysema. Wound dressed and washed with corrosive. Clean, healing well. Had a very good night; slept about eight hours and coughed very little. Twenty-four-hour amount of sputum, $4\frac{1}{2}$ oz.

August 30: X-ray taken this morning. Patient comfortable. Coughed very little. Comfortable night with very little coughing.

August 31: Comfortable day; very little coughing. Complained of shortness of breath during the night and was unable to sleep quite as well as usual. Some coughing this morning.

September 1: Dressing changed; stitch removed. Wound in fair condition. Patient passed a comfortable day. Had bad coughing spell at 4.30 a.m. Twenty-four-hour amount of sputum, 6 oz.

September 2: Patient up and about ward; comfortable day. No lameness in arm. Some coughing at night.

September 3: Comfortable day. Appetite good. Colour improving. Not much coughing in the morning; more coughing in the evening. Twenty-four-hour amount of sputum, $5\frac{1}{2}$ oz.

September 6: Patient up and about. Dressing changed. Some pus discharges from lower end of wound. Balsam Peru applied after cleansing with corrosive.

September 14: General condition of the patient fair. Cough shows some improvement. Given a second injection of nitrogen, 1,000 c.c.

September 16: Examination shows above the fourth rib in right front and the level of the mid-scapula behind, there is dullness, increased resistance, bronchial breathing, increased vocal and tactile fremitus, scattered medium moist râles. On the left side, below the angle of the scapula behind, breathing has amphoric quality, respiration is much diminished and there is evidence of gas. Above this level there is dullness, retraction of lung, with bronchial breathing and scattered medium moist râles.

September 26: Temperature, 97.4° F. Pulse, 140. Weight, $85\frac{3}{4}$ lb. Stomach giving some trouble, but cough and expectoration light. General condition about the same.

October 7: Temperature, 98° F. Pulse, 128. Weight, 87 lb. Appetite better, cough moderate. Raises 3 oz. in twenty-four hours. No pain or night sweats.

October 14: Weight, 87½ lb. Cough moderate. Raises about 1 oz. in twenty-four hours. By means of thoracentesis patient given 800 c.c. of nitrogen gas.

October 29: Cough and expectoration have decreased one-half since last injection. Examination shows a large body of nitrogen still present.

November 7: Weight, 87½ lb. Very little cough until within last few days. Hardly raises 1 oz. in twenty-four hours; no night sweats; appetite fair. Examination shows a persistence of the signs over the right upper lobe, but less evidence of activity; signs of cavity in the upper left chest indistinct. Râles still persist.

November 15: Temperature, 97° F. Pulse, 130. Weight, 87½ lb. Heart action poor. Considerable dyspnœa, brought on by exertion. Condition poor.

December 15: Patient given an inoculation of nitrogen to the amount of 900 c.c. Considerable persistent pneumothorax previous to injection. At entrance of 500 c.c. patient began to have pressure over stomach with gaseous eruction. Further injection seemed to increase distress. Injection abandoned at 900 c.c., tympanitic area being definitely limited above, but extending downwards over stomach. On removal of needle emphysema immediately occurred in the skin of the axillary region in the back. Needle re-introduced and connection with manometer. When escape of gas was permitted, water in manometer was blown out entirely. More escape then permitted into basin of water until at inspiration water entered too. This relief of tension relieved patient.

December 21: Temperature, 97° F. Pulse, 124. Weight, 88 lb. Cough has improved considerably. Very little expectoration. Patient troubled with some pain in the left shoulder.

January 13, 1911: Temperature, 97° F. Pulse, 112. Weight, 86 lb. Examination shows in right chest area of dullness diminished one-third over previous examination. Breathing broncho-vesicular in type. A few dry râles persist. In the left chest expansion is much limited and there is evidence of collapse of the lower lobe, with distinct breathing. Over the upper lobe there is intense bronchial breathing with numerous moist râles.

January 25: Temperature, 97° F. Pulse, 124. Weight,

83¼ lb. Patient has not done so well since last report. Cough has increased and expectoration is troublesome. Heart action is poor.

February 17: Patient sick at home and unable to report.

Discussion.—The action of pneumothorax therapy in this very advanced case has been noticeable in that it has aided in the retardation of a process in the right lung. Following each injection of nitrogen gas there was a noticeable relief from symptoms, and as long as heart action remained fairly good the patient improved. The diminution in cavity signs as a result of compression was noticeable. Had the effect of the disease been less pronounced in its action on the heart muscle, even in so advanced a case, much might have been hoped for in the way of prolonged life.

Case 18.—R. R., female, white, widow, aged 26. Occupation, housemaid.

Family History.—Negative.

Past History.—Except for frequent colds, has always been well. No children.

Present Illness.—Three weeks ago caught cold, which lasted for several days. On this account has been under observation at the Massachusetts General Hospital. An examination of sputum showed tubercle bacilli. Cough has persisted and there is some expectoration every morning. During the past seven weeks patient has lost 8 lb. in weight. Periods are regular. Patient has been under observation at the Good Samaritan Day Camp since February 7, 1910. There has been some slight improvement in general physical condition, but the process in the lungs has shown little change.

Physical Examination.—Fairly well developed and nourished. Chest fairly well developed; some flattening of outline below clavicles on both sides. Heart action regular and forcible; pulmonic second accentuated. Apical outlines narrowed on both sides; excursion at the bases of lung much limited on both sides. On the right, above first rib in front and the spine of the scapula behind there is dullness, increased resistance, bronchial breathing, increased tactile and vocal fremitus, an occasional fine dry râle. On the left side, above the fourth rib in front and throughout the left back, there is dullness and increased resistance, most marked at

the apex. On the upper half of this area vocal and tactile fremitus are much increased with bronchial breathing, which becomes broncho-vesicular and distant as base is approached. Throughout this area there are scattered coarse and medium moist râles.

Operation.—Novocain and adrenalin anæsthesia. Patient in right demi-dorsal position. Area selected for injection in anterior axillary line just medianwards to border of latissimus at level of left nipple. On exposure of the pleura it was found to be translucent and whitish. Upon introducing Brauer needle manometer was found to record a respiratory excursion, which proved that adhesions are not always present where pleura is thickened. Nitrogen flow was not rapid and promptly caused pleurisy pain and increased short respirations. Nitrogen 1,000 c.c. injected, when it was decided that tension pain was too great and wound was closed in layers. At end of operation patient was no longer complaining of pain. Chest strapped with adhesive.

August 30: Patient shows little or no discomfort as result of operation to-day, cough has lessened perceptibly. Examination shows a fairly extensive area of pneumothorax, localizing itself in the lower left front of the chest. Râles in left chest are much fewer. No activity at right top.

September 19: Patient has improved considerably in general condition since nitrogen has been injected. No cough, practically no expectoration. Examination shows presence of pneumothorax with very little activity of the pulmonary process on the left side and none on the right.

September 21: Patient has left the Day Camp without any apparent reason and has moved away from former residence. Efforts to find her have been entirely unsuccessful.

Discussion.—In this case, the effect of nitrogen injection, so far as we have been able to observe it, was that of effectively checking the spread of the pulmonary process at the right apex and limiting very materially that of the left side. While this was an advanced case, we feel that it was one which, under a period of nitrogen treatment, should have had a favourable outcome, especially as the lung was found to be collapsible to a large degree.

Case 19.—W. G. J., white, married, aged 23. Occupation, housewife.

Family History.—Negative.

Past History.—Unimportant.

Present Illness.—About one year ago, after a cold, patient began to have cough and expectoration, which have constantly continued and increased. Night sweats have occurred off and on; there has been some loss in weight, but no hæmoptysis. Appetite at present is fair. Marked weakness; some shortness of breath.

August 30, 1910: Admitted to Tent Ward, Massachusetts General Hospital. Coughed some; sputum none.

August 31: X-ray of chest taken before operation.

Physical Examination.—Fairly well developed and nourished. Colour fair. Skin negative. Chest flat, poorly developed. Depressions below clavicle on both sides, more marked on left. Area of heart dullness increased to left. Action regular, forcible. Pulmonic second accentuated. Pulse regular, rapid, full volume, low tension. Fingers slightly clubbed. Apical outlines narrowed on both sides. Expansion at right base fairly good. In right chest above second rib in front, mid-scapula behind, increased dullness, resistance, limited expansion. Bronchial breathing. Increased vocal and tactile fremitus. Scattered medium dry râles. Dullness through left chest. In left front and extending well down to angle of scapula behind, limited expansion and increased resistance. Numerous scattered coarse moist râles. Cavernous breathing below left clavicle in front. Some dullness and increased resistance to percussion at extreme left base.

Operation.—August 31: Novocain and adrenalin anæsthesia. Patient in left semi-dorsal position. Points of tympany selected 4 in. to left of left nipple, just anterior to the anterior axillary line. Skin incision of $1\frac{1}{4}$ in. was followed promptly by a faint sensation on the part of the patient, whose head was lowered. Pulse, 64. Operation continued with exposure of a clearly transparent pleura, through which the lung could be seen non-adherent. Needle inserted and 600 c.c. of nitrogen injected. Nitrogen flow was very gradual, doubtless because of low water pressure produced in emptying the last cubic centimetre of nitrogen from reservoir. Intercostal muscles sutured with three catgut stitches. Serratus and latissimus fibres approximated and skin closed with interrupted s.w.g. Patient returned to ward feeling rather faint. Pain at point of incision.

September 1 and 2: Patient fairly comfortable; a little coughing; no sputum.

September 3, 4, 5 and 6: Patient making a good recovery from the operation; sleeps and eats well; coughs a little; sputum quantity for twenty-four hours averages from 2 to 4 dr. On September 6 dressing was changed, sutures removed, and zinc ointment applied. Wound looking well. Patient discharged relieved to Out-patient Department.

Subsequent History.—September 12: Temperature, 97° F. Pulse, 112. Weight, 91 lb. Since having had pneumothorax therapy cough has diminished, but expectoration has increased. Feels somewhat better. Appetite is good.

October 5: Temperature, 99° F. Pulse, 96. Weight, 95½ lb. Feels somewhat stronger. Cough is troublesome, but there is practically no expectoration. Pneumothorax performed by thoracentesis in the anterior axillary line, and 1,200 c.c. nitrogen injected without discomfort.

October 21: Weight, 95 lb. Cough has materially improved. Expectoration, total amount in twenty-four hours is 1 dr.

November 2: Weight, 92½ lb. Patient has taken cold and as a result bronchitis has developed. All symptoms are aggravated.

November 16: Weight, 91 lb. Cough is still troublesome but there is very little expectoration. Examination shows evidence of persistence of pneumothorax in lower portion of the left pleural cavity. The lung is somewhat collapsed, but there is considerable activity in the left upper lobe. On the right side there is very little change in symptoms, except for some diminution in the amount of activity.

December 15: Pneumothorax performed in same area as before and 1,300 c.c. of nitrogen injected without symptoms. Cough is entirely dry and except for general weakness patient feels fairly well.

January 6, 1911: Temperature, 96° F. Pulse, 120. Weight, 88¾ lb. Cough is at present troublesome. There is still practically no expectoration. Examination shows a rapid weak heart, but very little change in pulmonary signs, except in some tendency of compressed lung to expand. There is very little pulmonary activity.

January 20: Temperature, 96° F. Pulse, 118. Weight, 87 lb. Cough is dry and harsh, with no expectoration.

General strength is failing and heart action is poor. It does not seem wise on this account to continue injections of nitrogen gas.

May 1: Patient has been in bed since last report constantly. Has recently developed a temperature. Pulse is high and of poor quality. Expectoration has returned in moderate amounts.

Discussion.—It has been noticeable in this case, although it was an advanced bilateral one, that considerable pulmonary compression was possible as a result of the lung collapse. While at no time has there been an entire suppression of activity in the chest, the total lack of expectoration while under treatment has been a noticeable feature. As in others of our advanced cases the heart muscle has given out and this has obliged us to discontinue our efforts.

Case 20.—M. M., female, white, single, aged 19. Born in Massachusetts. Occupation, lip blackener, shoe factory.

Family History.—Father died of phthisis six years ago. Sick one year. Patient's mother, three brothers, and three sisters well. One sister died in infancy.

Past History.—Measles, diptheria at 8. Malaria eight years ago. Periods never regular. Last appearance three months ago.

Present Illness.—Has had a cough for a year, starting with a cold. Raises small amount of sputum. A year ago raised about a quarter of a cupful of blood. Never any night sweats. Feels pretty strong. Appetite good. Bowels regular. Best weight, 134 lb. (with clothes). To-day (January 4, 1911), weight, with clothes, 116 lb. Tubercle bacilli in sputum.

June 4, 1911.—Cough continues about the same, somewhat hoarse. No night sweats or pains.

Physical Examination.—Fairly well developed and nourished. Colour fair. Heart slight enlarged to left. Pulsation seen over precordia. Apical outlines narrowed and contracted, dullness and signs of consolidation throughout greater part of right chest, scattered musical moist râles present. In upper two-thirds of left chest signs of consolidation and marked activity. Numerous fine medium and coarse râles, signs of cavity in upper left front.

July 6: Patient coughing less, raising about half as much

sputum as formerly. Examination shows on the right side above the second rib in front and the spine of scapula behind, dullness, bronchial breathing, increased vocal and tactile fremitus and a few fine moist râles. Similar signs are present on the left side, but they extend down to the fourth rib in front and the sixth behind.

July 13: Examination of throat shows thickening of both vocal cords, slight induration of anterior surface right of arytænoid with ulceration.

August 8: Examination about as at last; note no improvement.

August 10: Patient has been better. Expectoration diminished one-half. On right, above second rib in front mid-scapula region behind, dullness, resistance, slight increase vocal and tactile fremitus, bronchial breathing, scattered distant indistinct râles in mid-back.

August 18: Pneumothorax therapy was determined upon in the effort to check the pulmonary process.

Operation.—Patient in dorsal position. Point selected in anterior axillary line 2 in. below fold of axilla, 5 in. outside of nipple. Seemed to be desirable spot for injection between pectoral and latissimus fibres. Proved, however, to be deep with fat and without muscle support. Depth of pleura was almost 3 in. when exposed. Cocainization satisfactory with its usual semi-toxic effects. Lung could not be seen beneath pleura probably owing to bad light. Large sharp Brauer needle inserted perpendicularly causing immediate escape of air. 1,000 c.c. of nitrogen injected without causing symptoms. Intercostals sutured with three interrupted plain catgut sutures. On examination after operation tympany was found to extend upward anteriorly and posteriorly, proving the success of the injection.

September 10: Examination: On left, above angle of scapula behind and fourth rib in front, dullness, bronchial breathing, increased resistance, increased vocal and tactile fremitus and numerous coarse moist râles. Lung evidently compressed in front, breathing amphoric. In front above third rib heart sounds transmitted, below level of dullness percussion notes slightly tympanitic, more especially in front. Breathing and fremitus diminished.

September 12: Thoracentesis was performed in left axillary line and 1,200 c.c. of nitrogen were injected.

October 4: Thoracentesis was performed, same location, and 1,300 c.c. nitrogen were injected.

December 5: Coughing considerable. Caught cold about a week ago. Left apex dull to flat down to second rib in front and spine of scapula behind, below which there is a hollow resonant note, many coarse and medium moist râles throughout left chest, very loud at apex, but somewhat distant below. Slight dullness at right apex with increased fremitus and fairly numerous medium moist râles.

February 14, 1911: General condition good. Colour fair. Cough moderate. Amount of expectoration slowly diminishing; about 1 oz. in twenty-four hours. There are still tubercle bacilli in the sputum. Examination shows some dilatation of the heart. Signs of consolidation remain unchanged, except for retraction at both apices. Only an occasional dry râle is to be heard on the right side, and a few musical and moist râles on the left. Below the angle of the scapula there is an area of hyper-resonance, with diminished respiratory sounds, indicative of a pneumothorax.

March 14: Patient doing fairly well. Heart action somewhat weak. Pulmonary process has shown no advancement. By means of thoracentesis the patient was re-inoculated with nitrogen gas, receiving 1,300 c.c.

May 1: General condition fairly good. Cough and expectoration unchanged from last note. Circulation not as good as previously. Pneumothorax has been absorbed and there is some evidence of re-expansion of the lung.

Discussion.—In this case we feel that while the outlook for recovery is doubtful, the treatment by pneumothorax has materially aided in checking the advance of the disease.

Case 21.—A. C., female, white, married, aged 34. Housework.

Family History.—Father died from alcoholism. Mother living. One sister died two days' labour; one brother killed. Two brothers and two sisters well.

Past History.—Intestinal colic as a girl. Nineteen years married. Three children; one miscarriage fourth month. Two of the children died of scarlatina. Has been in U.S.A. five years. Went to Italy three years ago and returned here last February.

Present Illness.—Three days before landing began to

cough, pain in chest, fever, night sweats, no blood in sputum, general malaise, headache, fever. Cough keeps her awake at night. No appetite.

Physical Examination.—Fairly well developed and nourished. Thin. Fair colour; tongue clean; median line teeth good. Weight, 106 lb. Chest poorly developed, flat. On right, above second rib on right and spine of scapula behind, dullness, broncho-vesicular breathing, increased vocal and tactile fremitus, and numerous moist râles. On left, above fourth rib in front and angle of scapula behind, dullness, bronchial breathing, vocal and tactile fremitus increased, few dry râles. Case an advanced one.

March 14, 1911: Inoculated by Forlanini method with 400 c.c. of nitrogen gas into left pleural cavity in lower anterior line. Some diaphragmatic pain.

May 5: Has had considerable discomfort. Weight, 100 lb. Cough less up to last night. Is not so much troubled with night sweats. Except for the pain on side she would feel better. She has some dyspnœa which troubles her. Has not menstruated since February, 1911.

June 6: Examination shows pneumothorax has been practically absorbed. There are only occasional dry râles over the area of consolidation on the right side. Cough is still troublesome, though expectoration is somewhat diminished. Patient given an injection of 1,000 c.c. of nitrogen gas.

June 21: About the same. Cough still troublesome, but expectoration less. Examination shows lung expanded since last injection. Scattered medium and dry râles over consolidated area, both apices. No pneumothorax. Pneumothorax performed in lower axilla. 800 c.c. given.

Case 22.—F. G., male, white, married, aged 36. Occupation, machinist.

Family History.—Father and mother living. Six brothers and four sisters well.

Past History.—Negative. Denies venereal. Five years married. Two children. Wife well.

Present Illness.—Three months ago began to feel run down; cough; weakness; no blood in sputum.

April 20, 1911: Took to bed and was in bed twelve days with pneumonia; had night sweats, cough, fever, pain in side.

Physical Examination.—Fairly well developed and

nourished. Thin; tongue clean; median-line teeth good; pupils react equal; knee jerks; chest flat. Depression below clavicle. On left side above mid-scapula behind and third rib in front there is dullness, bronchial breathing, increased vocal and tactile fremitus and numerous dry râles. On the right side, above second rib front and the spine of the scapula behind, there is dullness, bronchial breathing, increased fremitus, both tactile and vocal, and an occasional râle. Nitrogen injected by the Forlanini method in the anterior axillary line on the left side; 400 c.c. introduced without discomfort.

Subsequent History.—May 16: Cough less, expectoration slight. Weight, 117 lb. On left, above mid-scapula behind and third rib in front, dullness, bronchial breathing. Increased vocal and tactile fremitus, occasional dry râles. Below dull area there is moderate tympany upon percussion, diminished fremitus and respiratory sounds. On right, above second rib front and spine of scapula behind, signs as on left.

June 6: Patient at present has no symptoms. Feels better. Examination shows signs of consolidation on the right side much less marked. On the left side there is evidence of lung compression with an area of tympany over the lower lobe. A few dry râles persist on the area of consolidation. By means of thoracentesis patient was given 800 c.c. of nitrogen gas. Injection was given in anterior axillary line. There were no symptoms following the production of pneumothorax.

June 21: Working and feeling well. No cough.

Case 23.—A. R., male, white, aged 42. Occupation, labourer.

Family History.—Negative.

Past History.—Small-pox at 16 years of age. In June, 1895, was sick in bed for three months with cough, chest pain, and fever. One pulmonary hæmorrhage occurred lasting eight days. Patient returned to Italy staying there for fourteen months. Nine years ago had a similar attack accompanied with cough and hæmoptysis, with an occasional night sweat. He has never been well since.

Present Illness.—At the present time is coughing constantly and for the past three weeks has raised blood, at times in considerable quantity.

Physical Examination.—Fairly well developed and nourished. Colour fair. No temperature. Weight, 120½ lb. Chest poorly developed. Apices restricted. Chest much flattened on the left side. At the right apex above the first rib in front and the spine of the scapula behind there is dullness, broncho-vesicular breathing, and an occasional râle. On the left side signs of cavity are present over the second to the fourth rib in front, extending into the axilla. Signs of consolidation are marked over the upper two-thirds of the chest in the back. Numerous râles over this area. Pleural friction at the left base. Sputum positive. By means of thoracentesis in the mid-axilla on the left side the patient was given 800 c.c. of nitrogen gas. This produced very little discomfort.

May 12: Previous to the injection of nitrogen gas the patient was raising some blood. This diminished after the operation and has not returned. Feels somewhat stronger. The amount of expectoration has diminished. Weight, 100½ lb. Examination shows that the signs of cavity are less marked. There is no activity on the right side and there is some diminution in the amount of activity on the left side. Pneumothorax performed and 900 c.c. of nitrogen gas injected as before.

June 3: Cough slight. Expectoration diminished one-half. Working steadily and feels somewhat better. Weight, 126½ lb. Examination shows the persistence of pneumothorax at the left base. Some friction in mid-left back. Given 900 c.c. nitrogen gas.

June 21: General condition somewhat improved. Cough troublesome. Expectoration is slowly diminishing in amount. Weight, 126 lb. Working. Examination shows signs at the right apex are less intense. On the left side pneumothorax present at the extreme left base posteriorly. Signs of cavity in lower left front and axilla are marked. Below the angle of the scapula there is a coarse friction râle, with fine pleural râles in the left lower front. The left lung shows some evidence of re-expansion. Patient given an injection of nitrogen gas to the amount of 1,300 c.c., most of it going toward the diaphragm.

Discussion.—In this case improvement has been marked, especially as the patient is obliged to continue work.

Case 24.—N. L., male, white, single, aged 19.

Family History.—Father died of pneumonia last year; one brother by accident; two brothers died in infancy.

Past History.—At 9 years of age had pain on left side, was very severe at first.

Present Illness.—Fourteen months ago general weakness, cough, fever, night sweats, blood in sputum; gradually losing weight. Three months in sanatorium one year ago.

Physical Examination.—April 29, 1911: Fairly well developed and nourished. Thin, skin dry and hot, tongue clean, teeth good, pupils react. Weight, 90 lb. Examination shows both apices involved, more marked on left side. Signs of consolidation above second rib on right and fourth on left. Râles few and fairly dry. Some dullness at extreme left base.

Inoculated by Forlanini method in anterior axillary line, 300 c.c. injected, and then operation stopped by pain. Nitrogen flowed slowly and with difficulty, but under little pressure. A small pleural sac probably surrounded by adhesions distended by nitrogen, no pneumothorax demonstrable.

Case 25.—J. D., male, white, single, aged 17.

Family History.—Negative.

Past History.—Negative.

Present Illness.—For about three months has been ill, beginning with a cold and pain in the lower left back. He has steadily lost weight, has grown short of breath, and is constantly coughing. Tapped without result two weeks ago.

Physical Examination.—April 29, 1911: Fairly well developed and nourished. Colour fair. Heart pushed 3 cm. to right of sternum. Left chest flat throughout. Below angle of scapula behind and fourth rib in front flatness, increased resistance, absent fremitus and respiratory sounds above this area, dullness, bronchial breathing behind and vesicular in front, no râles heard. At right apex dullness, increased resistance, bronchial breathing. Tapped in eighth space, no fluid obtained, needle went through thick mass of thickened pleura.

Discussion.—This case was one in which, on account of adherence of the visceral and parietal pleura, with marked thickening, lung collapse was impossible. Patient was therefore rejected as unsuitable for pneumothorax therapy.

Case 26.—J. A., female, white, married, aged 29. Occupation, housework.

Family History.—Father and mother living; three sisters, one brother dead.

Past History.—Six years in U.S.A. Six years married; four children, last one born March 15, 1911. Erythema nodosum last year.

Present Illness.—Ten days' cough, pain in chest, fever, general weakness, headache, "all-gone" feeling, appetite poor, bowels regular. Temperature, 102° F. Pulse, 120. Respiration, 30. In bed for three days, night sweats, cough very troublesome.

Physical Examination.—May 5, 1911. Well developed and nourished. Poor colour. Pupils react. Tongue coated. Tubercle bacilli in sputum. In the right chest, above the second rib in front and the spine of scapula behind, there is dullness, broncho-vesicular breathing, and an occasional fine, dry râle. On the left side, above the third rib in front and mid-scapular region behind, there is dullness, bronchial breathing, increased vocal and tactile fremitus, and an occasional moist râle. Nitrogen injected in the left anterior axillary line, 1,000 c.c. introduced.

May 12: Following the production of the artificial pneumothorax there was a great deal of discomfort, pain, and weakness. Had to lie down for two and a half hours. Pulse 120, rather weak, gradually grew stronger and came down to 96. Vomited half an hour after taking morphia. Seen at home in the night, was comfortable in bed and resting, though complaining of pain and heaviness on left side.

May 14: Up and about; feels better, but complains of pain on the left side. Is taking food well.

May 16: Weight, 123 lb. Examination shows on the right side that there is now only slight dullness at the apex behind. Respiration is harsh throughout the chest. On the left side, below the fifth rib back and front, there is tympany, with diminished fremitus, respiratory sounds. Above this area there is dullness, bronchial breathing, rare, dry râles.

June 3: General condition good. Cough slight. Raises ½ oz. in twenty-four hours. At left base percussion note slightly tympanitic, respiratory sounds diminished. An

occasional dry râle at left apex in front. Patient given injection amounting to 1,000 c.c. of nitrogen.

June 21 : Feels fairly well. Cough diminished and much drier. Weight, 121½ lb. General condition improved. No pneumothorax present. No activity on right side. On the left side, few scattered râles, especially in left front. Patient given an injection of nitrogen gas to the amount of 600 c.c., gas going anteriorly.

Case 27.—G. D'A., male, white, single, aged 30. Occupation, labourer.

Family History.—Father and mother living and well. Two brothers, three sisters well.

Past History.—Pleurisy eight years ago, while a soldier in Italian army. Seven years in U.S.A. One year ago began to cough and has had this cough off and on ever since. At the beginning of cough spat blood for two days, none since.

Present Illness.—Two weeks, cough and night sweats. Pain on coughing at mid-sternum.

Physical Examination.—May 5, 1911 : Well developed and nourished. Good colour (blood). Pupils react. Tongue clean. Weight, 148 lb. In the left chest, above the first rib in front and the spine of the scapula behind, there is dullness, broncho-vesicular breathing, increased vocal fremitus. On the right, above the third rib in front and the seventh rib behind, there is dullness, bronchial breathing, increased vocal and tactile fremitus, numerous medium and coarse moist râles. At the extreme right base respiration is limited. Tubercle bacilli in sputum.

May 12, 1911 : Artificial pneumothorax performed. Anterior axillary line, level with the fourth rib, selected for the point of injection, and 400 c.c. of nitrogen gas introduced. At end of introduction of gas patient had fainting sensation, but soon recovered and was able to dress and leave.

May 14 : Cough less, raises less sputum, does not have any night sweats. Pain at site of puncture on coughing. Feels better to-day.

May 16 : Examination shows on the left side an area of dullness much diminished, and respiratory sounds normal. On the right side, above first rib in front, fourth rib be-

hind, there is dullness, broncho-vesicular breathing, and no râles are heard. Below the level of the fifth rib in front and angle of scapula behind there is a tympanitic note on percussion, with diminished respiratory sounds.

June 6: Examination shows persistence of pneumothorax at the right base. Some slight expansion of lung, with a re-appearance of a few râles in right front. Patient given a second injection of 1,200 c.c. of nitrogen, which was endured well; no cardiac displacement.

Case 28.—V. T., female, white, married, aged 29.

Family History.—Mother died in confinement. Sisters and brothers well.

Past History.—Married eight years. Three children, miscarried third month one month ago.

Present Illness.—Three months' pain in chest, cough. Night sweats. Appetite poor. Bowels regular. Great deal of sputum. No blood noticed in it.

Physical Examination.—May 6, 1911: Well developed and fairly well nourished. Fair colour. Tongue clean. Median-line teeth good. Pupils react. Weight, 123 lb. Tubercle bacilli in sputum. On the right side, above the second rib in front and the spine of the scapula behind, dullness, increased resistance, vocal fremitus, increased bronchial breathing, an occasional dry râle. On the left side there are signs of consolidation above the fourth rib in front and the angle of the scapula behind. Over this area are numerous moist râles, both coarse and fine. By means of thoracentesis in the eighth space anterior axillary line 500 c.c. of nitrogen were injected without discomfort to the patient.

May 12: No night sweats. Feels heavy on injected side; weight, 123½ lb. Examination shows the signs of consolidation at the right apex are less marked. Dullness less intense, breathing less bronchial. On the left side there is an area of tympany at the extreme left base. Above this area signs of pulmonary infection remain unchanged. Patient re-injected in the eighth intercostal space in the posterior axillary line, 900 c.c. of nitrogen gas introduced.

May 16, 1911: No night sweats; sputum temporarily increased, following last inoculation. General condition improved; weight, 123½ lb. Examination shows right apical

signs to be slight. On the left side tympany extends up to the level of the fifth rib behind. Over this area fremitus and respiration sounds are much diminished. No râles are present over the area of consolidation at the left apex. Heart is somewhat displaced toward the right side.

June 3: Weight, 125 lb. Cough slight, no expectoration; looks and feels well. Examination shows pneumothorax has been absorbed. At the extreme left apex signs of consolidation persist, rare dry râles heard. Patient was given another injection of 700 c.c. of nitrogen.

June 21: Very little cough. No expectoration. Weight, 125 lb. Examination shows very little activity in chest. Occasional scattered râle in chest on left side. No pneumothorax present. Thoracentesis given in anterior axillary line and 600 c.c. of nitrogen gas injected.

DISCUSSION.

Dr. V. Y. Bowditch: From lack of experience I am not in a position to discuss this paper, although much interested in the subject. I confess I approach it with scepticism, although it has been before us for some time, through Murphy and others. My own attitude towards it now, however, may be perhaps expressed from the fact that I have asked Drs. Floyd and Robinson to see a case, which I now have at the Sharon Sanatorium, of abscess of the lung which, under hygienic conditions and some vaccine treatment, has improved a great deal, but which seems to be somewhat at a standstill, and there is still some bloody expectoration, though no tubercle bacilli can be found. There are some points that are not quite clear to me as to the reason of this method of treatment. For instance, Dr. Floyd advocates the compression of the lung in order to obtain rest, and yet in cases of double phthisis, when injecting one pleural cavity, he makes an exaggerated action of the other lung. How are these going to counteract each other?

Dr. C. L. Minor: I would like to ask what is the effect of the deflation of the lung upon the pulse and temperature.

Dr. J. H. Pratt: As I was favourably impressed with the papers of Brauer and Adolph Schmidt, I attempted to try the effect of therapeutic pneumothorax on selected cases of advanced phthisis that had not improved under the rest treatment. Dr. Robinson and I began this work in Boston. My place was soon taken by Dr. Floyd. This was not owing to loss of interest on my part, but because Dr. Floyd was in a better position than I to continue the work.

I hope the authors will publish a detailed account of their cases. This paper should prove of distinct value. The cases were more advanced than some of those reported by the German observers. I refer particularly to Schmidt. I believe some of his cases would have recovered under the open-air rest treatment as given in this country. I know that two of the cases reported by Floyd and Robinson were apparently hopeless. They had been in my tuberculosis class for some time, and there did not seem to be the slightest chance of recovery. As a matter of fact, the pneumothorax did not prevent the fatal issue. One of the patients, however, felt better after the injection of nitrogen. There was no improvement in the other case.

Dr. W. A. GRIFFIN: I have been privileged to see a few of Dr. Floyd's cases, and I have been impressed with the general improvement in the patients' well-being. The cough and expectoration were better, and the night sweats were less. Unfortunately, I did not see any of the cases before the injection, but I noted in one man in particular that there were certain definite signs set down in the records which were much less marked three or four days after the injection. Of course, the gas in the pleural cavity gives lessened respiration on that side, which might account for some of the differences noted.

It occurred to me that if the X-rays were used in connection with these injections it might be easier to determine when the gas had been sufficiently supplied, and possibly other valuable data might be obtained.

Dr. LAWRASON BROWN: About a year and a half ago, while visiting Davos, I saw at the Schatzalp Sanatorium, with Dr. Neumann, a number of patients treated by artificial pneumothorax. There they followed the cases systematically with the X-ray. They used the Brauer method of injection. I would like to ask Dr. Floyd, if he gets a case with a great deal of excavation and injects nitrogen gas, what happens to the chest wall? I would also like to know just exactly how much trouble can occur in the opposite side to make it safe to use this method. I had one patient in Davos, and the physicians there said the disease was too far advanced on the opposite side to use this method. I would like to know just how the limit can be determined.

Dr. E. O. OTIS: No mention has been made of the work of Dr. H. P. Loomis. His paper appears in our *Transactions* for the year 1900, and his results seemed to show that he obtained temporary improvement, but that ultimately these patients relapsed.

Dr. H. L. TAYLOR (St. Paul): Some years ago I treated a number of cases of consumption with injections of nitrogen gas, but I got no improvement, or not sufficient to warrant the continuance of the treatment, and I have given it up. One trouble is that you have

to follow your case for several years. Brauer reports cases injected off and on for three or four years before a permanent improvement was secured. Another thing was the danger of wounding the lung, and those cases of sudden death during the injection, due to entrance of the nitrogen into the veins, resulting in gas emboli.

The other day a man came to my office who was a sheep herder in Montana. He was suffering from consumption, and had to continue his work. He had a complete pneumothorax; no fluid whatever could we determine in the pleural cavity. The man was in excellent condition. The duration could not be determined, as he was not aware of the fact that a pneumothorax had occurred. This was the best result I have ever seen from any pneumothorax, either natural or artificial.

Dr. J. H. LOWMAN (Cleveland, Ohio): I would like to speak about the effect upon the lung from pleurisy with effusion. If the effusion is left subsequently, that patient may be better than if it is withdrawn, so that unless there is some grave reason, from the inconvenience of the patient, &c., I have allowed the effusion to remain to be absorbed more or less gradually, and I felt that the patient's subsequent career was better than if the fluid had been taken away. The repose and anchoring of the lung incident to the compression in a pleurisy with effusion will produce a desirable effect upon it. Now if that is so, and this has been corroborated by the man in charge of the hospital in Cleveland, are there not many cases which, if left alone, would ultimately do well? Another point which comes into these sudden deaths is that there may be some cerebral phenomena acting as the cause. It is common in these cases to have slightly temporary palsy which will last three or four hours, so another cause besides a gas embolus may be acting.

Dr. CLEAVELAND FLOYD: As to the point which Dr. Lowman has brought up with regard to the presence of effusion as improving the patient's condition, this is of great importance because it is on this fact that pneumothorax therapy is based. As regards gas embolus, it is one of the chief dangers in this method of treatment. If, however, the incision method is used, or when the technique of Forlanini is used, the respiratory excursion is always obtained before allowing an inflow of gas, there seems to be very little danger. In 1,350 injections of nitrogen gas Forlanini has had only one bad result. Brauer, I believe, had four from this accident. With regard to Dr. Bowditch's question as to the effect on the opposite lung from immobilization of the other, I would say that it seems that increased activity of the apex of the lung seems to improve the process there, whereas at the base it is detrimental. In certain cases which Brauer and Schmidt had, where, on the opposite side of the chest from the one treated, there was a process at the base, in these cases the base was made more active and the disease extended;

in the apex, however, the process was brought to a standstill. With regard to the effect on pulse and temperature which Dr. Minor asks about, I would say that temporarily the pulse is increased, later rapidly diminishing in rate. In acute cases the temperature also goes down. It has been difficult to get cases in Boston, and we have had practically to pick out the worst ones to get this treatment started. With regard to the X-ray, Brauer uses this both before and after the injection, and we have done the same in Boston. It shows exactly the position of the lung, where the disease is most extensive, but it is not possible by this to determine the amount of gas that is necessary. We have frequently begun with 400 c.c., and have led up to 2,000. Dr. Brown asked how much trouble in the opposite side of the lung we could have and yet employ this treatment. In the worst case that I have seen it was down to the second rib in front and in the region of the mid-scapula in the back, but the process was not very active. With regard to the amount of gas injected, it depends entirely upon the extent of collapsibility whether we give 400 c.c. for the first injection, or a larger amount. We have given it as often as there is evidence of re-expansion of the lung. I do not think I have seen any increased extension of the process on the opposite side in those cases we have been able to follow. If the patients do badly it is the flaring-up of the disease on the side injected, rather than increased activity on the opposite side.

FRESH AIR IN SCHOOLS AND HOSPITALS.

BY JOHN W. BRANNAN, M.D.,
NEW YORK.

(Illustrated by Lantern Slides.)

WHAT I shall attempt to show is the possibility of getting really fresh air into all of our schools and all of our hospitals. This idea goes back to the establishment, some six years ago, of Sea Breeze Hospital, where children suffering from bone and joint tuberculosis are absolutely in the open air all the time of the twenty-four hours, with the exception of a half-hour morning and evening, when the windows are partly closed while the children are washed and dressed and undressed. This practice has been extended to the children and adult patients in Bellevue and its allied hospitals in New York by the use of balconies attached to all the wards and by open windows and transoms. In the newest public school buildings in New York transoms are constructed over the doors of the class-rooms and halls. When these are left open and the halls are properly ventilated, a marked improvement in the air of the school-rooms can be obtained. The open-air classes for tuberculous children and for anæmic children in the public schools will also be described and shown in illustrations.

Beginning with Sea Breeze Hospital, the lantern slides show the wards with windows wide open at night even in midwinter. The children are warmly clothed in flannel, and wear hoods and mittens when necessary. During the day

they lie on beds on the open porches facing the ocean to the south. Throughout the spring and summer and autumn months they also sleep all night on the piazza adjoining the ward unless the weather is stormy. If the sky is clear, the canvas overhead is rolled back, so that there is nothing between the sleepers and the heavens above them. During school hours the children are in a room with open windows or in a tent with open sides.

We now come to Bellevue and its three allied hospitals, and see first a ward of the typical shape, 88 ft. long and 30 ft. wide, with the two long sides and one end freely exposed to secure light and air, and flooded with sunshine. The open transoms can be seen on the side to the right, but they are also open on the other side and at the farther end, and there is also an open transom over the door through which the photograph is taken. This is a mid-winter view. Surely there is no need here of the elaborate system of artificial ventilation that is usually provided in American hospitals. These hospitals were designed and constructed some three or four years ago, and each is equipped with a complete modern ventilating plant with double system of fans and ducts—this in deference to the views of the architects and the prevailing American practice. For the past two years, however, the artificial system of ventilation has been discontinued in all four hospitals, and the air in the wards has been kept sweet and pure and really fresh by means of open transoms and windows. There is but little complaint of draughts, though our patients are all accustomed to the close, stuffy air of their tenement homes. The temperature in the wards is kept below 65° F. in the winter, varying from 62° F. to 65° F. during the day, and in the neighbourhood of 60° F. or below at night. We should be more successful in regulating the temperature and the quality of the air if their importance had been impressed upon the

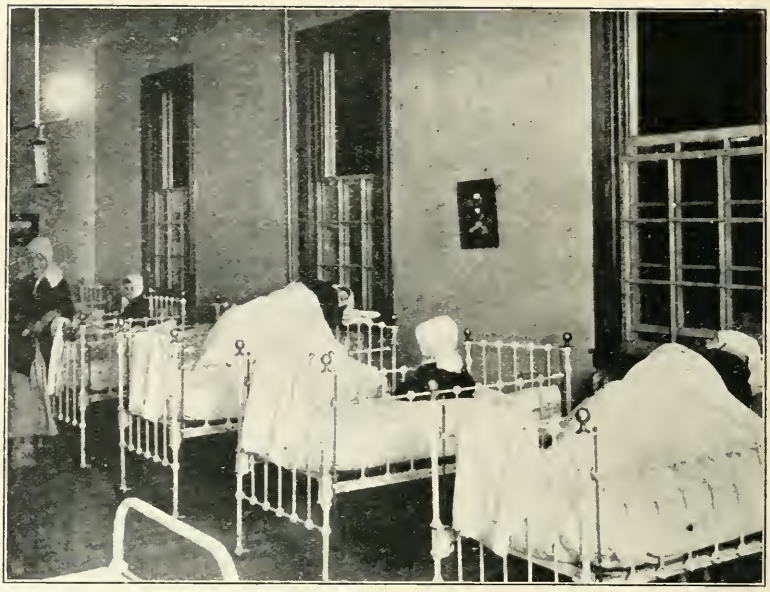


FIG. 1.—Sea Breeze Hospital. Mid-winter view of ward at night. Note open windows.

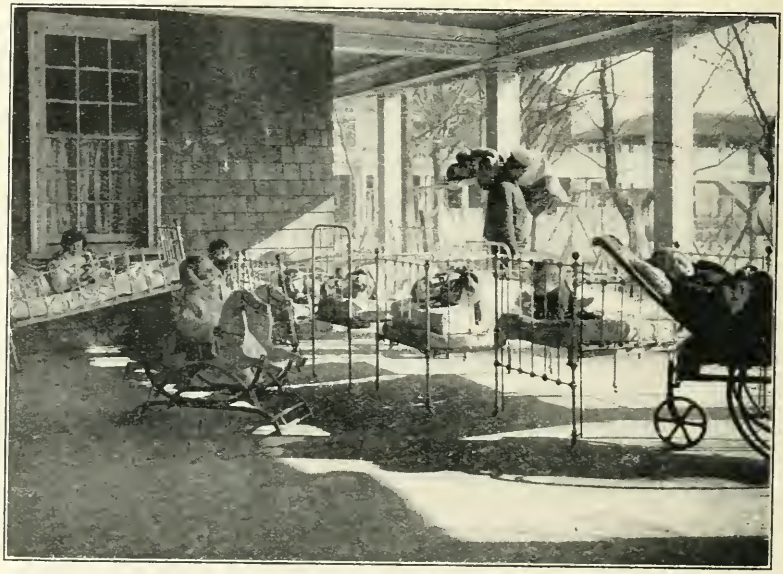


FIG. 2.—Sea Breeze Hospital. Winter view in late afternoon, showing method of carrying children from piazza to ward.

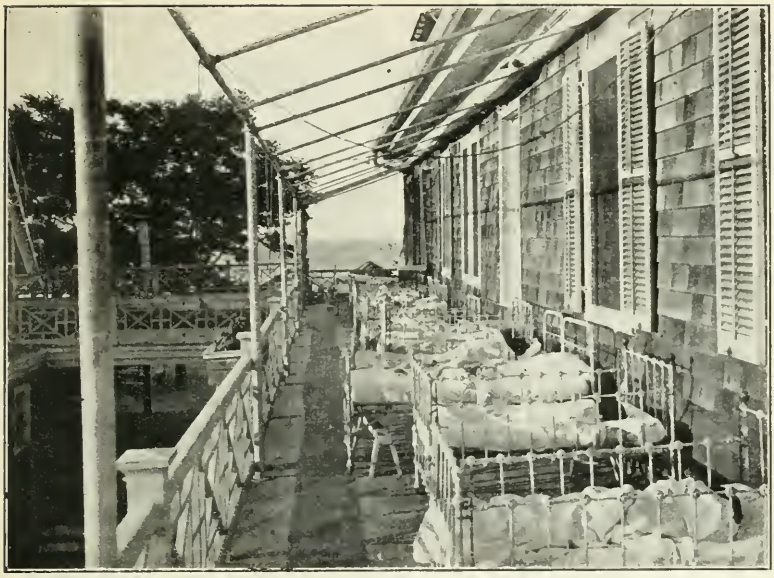


FIG. 3.—Sea Breeze Hospital. View at 6 a.m. in Spring. Children sleeping on porch all night. Canvas overhead rolled back.

FIG. 4.—Harlem Hospital. Winter view of ward, showing open transoms.

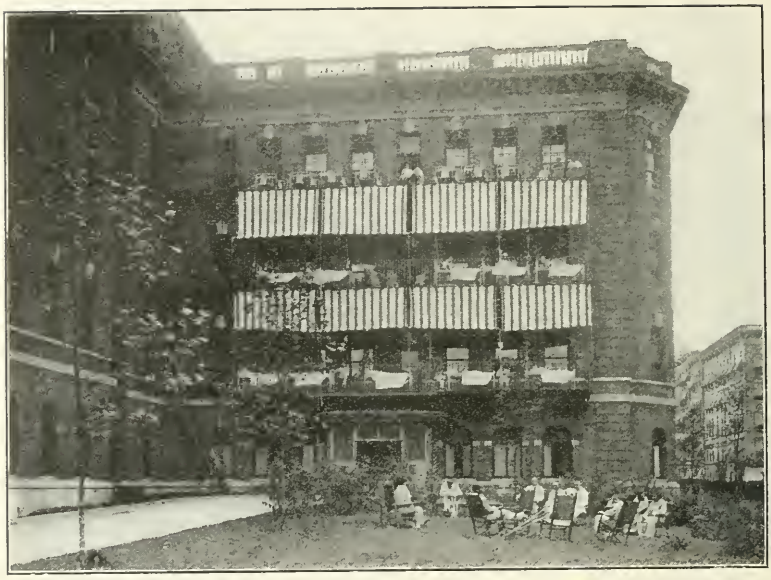


FIG. 5.—Harlem Hospital. Exterior view. Patients on balconies, also convalescent patients on grounds.

FIG. 6.—Bellevue Hospital. Open loggias facing East River.

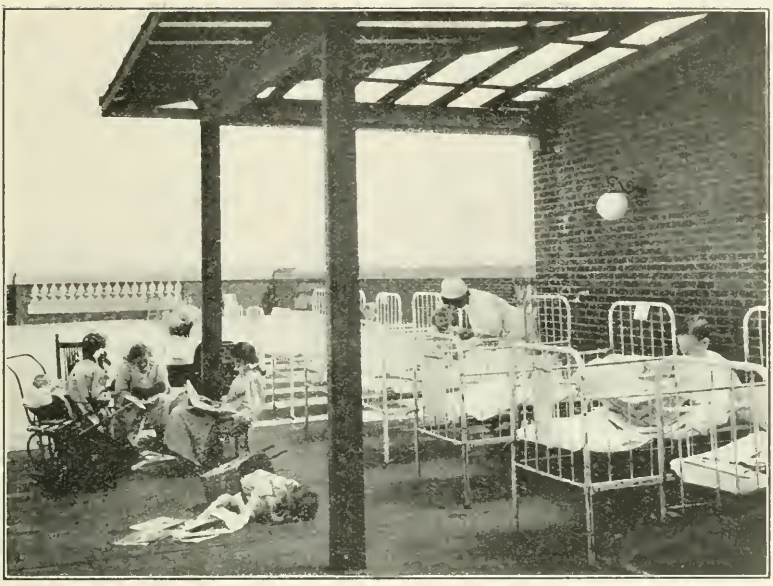


FIG. 7.—Bellevue Hospital. Roof scene.

FIG. 8.—Open-air School, Providence, R.I., showing windows trussed up to ceiling.

internes and the nurses before entering upon their hospital service.

Every ward is provided on one side with an open balcony, 8 ft. wide, generally extending the full length of the ward. A door wide enough to permit the easy passage of a bed, and *without a sill*, opens from the ward to the balcony. With properly adjusted weather strips it is very rare that rain or snow finds its way under the door, even in a driving storm. The storys of all the hospitals are 15 ft. from centre to centre, and with this distance between the balconies there is no shading whatever of the wards.

The double pavilions of the new Bellevue Hospital are connected by open loggias 60 ft. long and some 20 ft. wide. The loggias face the river, and, as shown in Plate 6, afford a commodious outdoor shelter for both bed and ambulant patients. They have recently been equipped with movable window sashes on one side at the ends adjoining the wards, so that the patients may be kept in the loggias even during the winter.

The hospitals are also provided with roof gardens, accessible from the wards by elevator. The balconies and loggias are so convenient to the wards that but little need of the roofs has as yet been felt. We are now beginning to use them more particularly for children, as shown in Plate 7. Plans are also being prepared for the construction of two open-air wards for convalescents on the roof of Fordham Hospital. These will enable us to care for patients whose beds in the regular wards are needed for acute cases, and for whom there is no room at the moment in the convalescent homes in the country.

We shall now pass on to a consideration of the open-air schools—first those established for children with pulmonary tuberculosis, who have been excluded from the public schools, and then the fresh-air classes, opened in the public

school buildings themselves, for children who are anæmic, under weight, and ill nourished, and are hence considered to be especially predisposed to tuberculosis.

The first of these schools in this country, with the exception of the hospital school at Sea Breeze, already referred to, was opened in Providence, at the instance of Dr. Jay Perkins, of that city. This was followed closely by the Franklin Park School in Boston. The Providence School is in an abandoned school-house from which a portion of the south wall was removed and replaced by windows which can be trussed up to the ceiling, as shown in the illustration. The Boston School is on the roof of a building built as a refectory in a public park. It is freely open on all sides; protection in stormy weather is secured by curtains which can be dropped as needed.

The results obtained in the above schools were so satisfactory that they were soon followed by the establishment of similar classes in Hartford, Chicago, New York, and other cities. Among these various classes the Graham School in Chicago is one of the most striking, inasmuch as the fresh air is obtained simply by raising the window sash of an ordinary class-room. Plate 9 shows the warmly-clothed children sitting in perfect comfort by the open window. The Bellevue and Gouverneur Hospital Schools are also of special interest. They are located on the upper deck of old municipal ferryboats, condemned as being no longer of use for their original purpose. Moored to the water front of the East River, each boat provides admirably for a group of children who have been excluded from the public schools because they have physical signs of pulmonary tuberculosis. The Bellevue boat also shelters on the lower deck a class of crippled children, crippled by bone tuberculosis no longer in an active stage. As shown in Plates 10 and 12, the classes are not held in the cabins of the boats, but are on

FIG. 9.—Open-air Class at Graham School, Chicago.

FIG. 10.—Open-air Class of Tuberculous Children on Ferry-boat "Southfield," at Bellevue Hospital.

FIG. 11.—Open-air Class on Ferry-boat "Southfield." Sleeping hour.

FIG. 12.—Open-air Class for Tuberculous Children on Ferry-boat "Westfield," Gouverneur Hospital.

the open deck or in the passages outside, looking directly upon the water of the river. In the Bellevue boat there are no windows on the two exposed sides; protection is afforded by canvas in case of a driving storm, but one side is always open. In the case of Gouverneur the upper sashes of the windows are always lowered. In Plate 11 the Bellevue children are seen during the rest hour sleeping on the open deck enveloped in blankets on the ordinary hospital beds. It is evident from the wraps worn by the teacher that the day is cold. As an instance of the results obtained in these outdoor classes, the last report of the Gouverneur teacher states that of 37 children who had been in the class for periods varying from six months to a year, 30 had been readmitted to the public schools by the physicians of the Board of Education. It should be added that the pupils have not only regained their health, but have also kept pace in their studies with the other children. The Board of Health also maintains two ferryboats, on which open-air schools are conducted in the same manner as at Bellevue and Gouverneur Hospitals. On the roof of the Vanderbilt Clinic, five storys above the street, is another class for tuberculous children, established some two years ago by the ladies' auxiliary of the clinic.

We now come to the latest development of the open-air teaching—the fresh-air classes for anæmic children established in the public schools by the Board of Education of New York. The first class was opened in April, 1910, in School 21, in Mott Street, the centre of the congested Italian quarter. All the children are of Italian parentage, and the parents are all very poor and live in very crowded tenements. No one of the children had any physical signs of disease, except enlarged glands in some cases, but their faces and figures, as shown in Plate 14, compare very unfavourably with those of the tuberculous children in the schools on the

ferryboats. It is evident that no mistake was made in their selection. The usual routine is followed. A hot, substantial midday meal is provided, followed by rest and sleep in extension chairs for an hour or more. Crackers and milk or bread and milk are also given at 10 a.m. and 4 p.m. During the past winter the children have gained in weight on an average over 9 lb. apiece, with a corresponding gain in all other respects. It is of interest to note that during the Easter recess of one week all the children lost weight, and many of them returned to school with colds, which promptly disappeared with two or three days of open-air life. In Plate 15 the children are shown sleeping on the broad balcony entirely in the open, the awning having been rolled back. When the weather is very stormy the school is held within doors, but the pivoted windows are widely open. Dr. Doty, the superintendent of School 21, reports that practically all the children in the school are anxious to join the fresh-air class.

Four other schools have been opened this spring. Two of them are in loggias which open directly on a park to the south and are on the level of the ground. The other two are in rooms fitted with pivoted windows on two sides, so that in all weathers there is a free circulation of air. The action of the pivoted windows is well seen in Plate 16, showing the children during the sleeping hour in the class in Public School No. 51. The Board of Education is preparing to open a large number of classes in the autumn, and it is expected that there will be twenty-two in operation by this time next year.

In the autumn of 1909, when it was first proposed to establish open-air classes in the public schools of New York, and the Department of Education asked the Board of Estimate and Apportionment for funds for alterations to the rooms and the equipment of the pupils, and salaries

FIG. 13.—Open-air Class for Anæmic Children at Public School No. 21, New York City. Winter view.

FIG. 14.—Open-air Class, Public School No. 21. Meal hour.

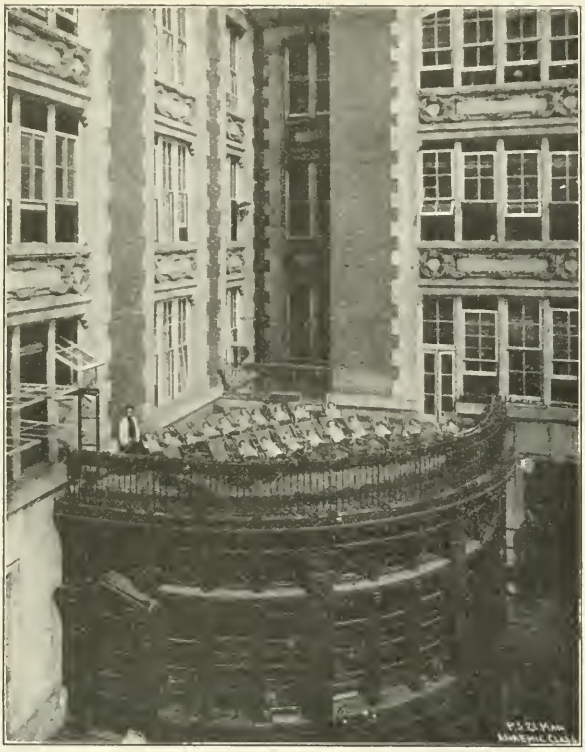


FIG. 15.—Open-air Class, Public School No. 21. Rest hour. Observe pivoted windows of class-room to the left.

FIG. 16.—Open-air Class for Anæmic Children in Public School No. 51, New York City. Sleeping hour. Pivoted windows on both sides of room.

for additional teachers, there was considerable objection raised by an association of taxpayers and even by one or two physicians. The former feared that the probable extension of open-air teaching, if the initial experiment proved successful, would involve the city in large expenditures; the latter were fearful that the children would be injuriously affected by the cold air. Apparently both groups of objectors have decided that their fears were groundless. At all events, since the opening of the first school we have heard of nothing but warm approval of the work and the desire that it should be extended as rapidly and as widely as possible.

DISCUSSION.

Dr. J. PERKINS: Dr. Brannan has shown in the pictures far better than words can show what these open-air schools are and what they are accomplishing. The work which we have done in Providence in connection with fresh-air schools has not been of the nature of hospital work, but as a part of the school system; that is, the school hours are the regular school hours, and the scholars are children who are below par. In this we have had three objects in view: First, to take care of any children who are physically below par, whether tuberculous or not, who have not been able to keep up with the regular school work. Our second object is to give the State or the city better value for the money expended, for it has been proved that children advance faster in these open-air schools than they do in the regular schools. It is not simply to help out these children, but to give the State or city a better return for its money. Our third object is to raise the standard of life throughout all the schools of the city, and that to me is an important thing in this work. The number of children affected with tuberculosis is very great, and until some means is taken to keep up the physical welfare of these children they will be a drag upon the State. A large part of them can be prevented from becoming tuberculous by this kind of a school, and it seems to me to be the right thing to begin preventive treatment and not wait till tuberculosis develops—to give them a hold on life, so that they can resist any active development of tuberculosis. As to the results which are obtained, Dr. Brannan did not go into that very much, so I would like to state a few of the results. Children who could not attend the ordinary schools with any degree of

regularity because of frequent colds, have attended these schools regularly, and have so improved in health as to return to the regular schools, and attend them successfully, making room for children who needed the fresh air more. The children are under the supervision of a school medical inspector, and are examined at the tuberculosis clinic of the R.I. Hospital. The work is a success from all points of view, the public has a good return for money spent, and from an educational standpoint it is also a paying venture. The scholars are followed to their homes by the nurse from our tuberculosis clinic to see that the hygienic measures are carried out as for tuberculous children, whether they are tuberculous or not. The Superintendent of Schools stated in his report: "More visitors call upon these schools than any other in the city. It is not now experimental, and to see the colour come into the cheeks and the sparkle to the eye, to see the emaciated forms fill out is something not easy to be forgotten." We all know how unfitted a child is for close and continued application to work during long periods, and yet most of our school boards expect the children to do this, time is spent in rooms which are anything but ventilated. We have teaching of the children in connection with our day camps and in and are even gradually giving up the time for recess, and all this connection with the hospitals for bone tuberculosis, but these are not properly fresh-air schools. One result is that a different standpoint is being taken, and a committee has been appointed, consisting of the Professor of Biology at Brown University and the Dean of Pembroke and myself, to try to raise the standard of hygiene in public schools, and I believe that my appointment is directly the results of these open-air schools.

Dr. J. A. MILLER: It is necessary, I think, to distinguish two classes of fresh-air schools, one for the tuberculous child and another for the anæmic and run-down child. They really need two distinct sets of treatment. I believe that the tuberculous child should be connected with an institution, such as a day camp or a hospital, for they need supervision and treatment, in addition to schooling. Quite distinct from them is the anæmic type, which belongs to the regular public school system; there they have the same number of school hours as other children, but, in addition, they have the fresh air, good food and rest in connection with their school work. Our children are required after lunch to lie down for two hours, during which they usually sleep, and it is really remarkable the improvement which follows even a short time of this treatment.

I cannot sit down without saying to you how much indebted we in New York are to Dr. Brannan for his devotion, energy and interest in this whole matter. We are on a fair road, largely through his influence, to having open air in every school-room in New York, and I feel sure this influence will extend far outside that city.

Dr. E. O. Otis: Dr. Brannan mentioned the fact that our fresh-air school had been closed in Boston through the influence of the Mayor; this is an error, as it was by an order of the Consumption Hospital Trustees, who maintained that if these children were really tuberculous then they should be provided for in a sanatorium for children; but if they were only anæmic then the schools authorities should look after them. There are two sets of children requiring this fresh-air treatment, the consumptive child and the anæmic child; the last the school authorities should take care of, the other the consumptive hospital authorities. I do not believe we have any exact knowledge as to the number of tuberculous children that are in our cities, and I do not know any other way of determining this than to have experts go through the process of examining all school children. Hence we need well-equipped school inspectors, and we have just placed out school inspectors in the city of Boston under Civil Service conditions, and I think this will ensure competency.

Dr. Egbert Lefevre (New York): An interesting point in relation to tuberculosis is the time of primary infection. It seems to me that most of our cases of tuberculosis are infected during childhood, and I have become more and more of the opinion that primary infection after school age is rare and rather the exception than the rule. And if we look to the children of school age we are doing more to eradicate tuberculosis than anything else. The child can be cared for very readily, and a proper routine of life can be established easily. But if that child is left, how often in later life we have the breakdown and dissemination of the malady.

Dr. V. Y. Bowditch: I just wish to say that the closing of the Franklin Park open-air school in Boston by the trustees of the Consumptives' Hospital was done by the majority against an earnest wish of the minority and a large number of citizens who believed that the trustees were making a serious mistake for insufficient reason.

Dr. Lawrason Brown: I should like to say a word with regard to transoms over the doors. There is a very great difference in the ventilation of rooms through transoms in corridors when there is heat in the building and when there is no heat. The warm air will come through the halls and go out of the window in winter, while in summer, of course, you can get proper ventilation through halls when there is no heat in the building. When I have the windows open in winter I close the transoms because I want the air to come from the outside and not from the hallway.

Dr. J. M. Anders (Philadelphia): Dr. Miller stated that the children in his school had but two hours a day for study, and yet kept up with their grade. This alone would emphasize the importance of the mode of treatment under consideration, and that while improving them physically they are to an equal extent improved mentally and morally. It seems to me that the human mind can

scarcely grasp the social and economic readjustment that will follow the wider adoption of the open-air schools.

Dr. H. M. BRACKEN: Why not put all our children in the open-air schools? We want in our schools not only the open air, but a lower temperature than is usual in the Boston schools, and we want a natural ventilation and not an artificial one. With regard to resting: From the pictures I see that the children are all on chairs. I cannot see why a cot is not easier to rest upon than a chair. We had a few cots that were used for children who had spinal trouble. They were of canvas, with a square frame and little legs. These could be turned up and the whole thing folded or rolled up, and I think these children could rest much easier on a cot such as this than on a chair, with its irregularities.

Dr. J. H. PRATT: To make the best use of the facilities at hand is a guiding principle upon which our President has long insisted. This advice needs to be repeated again and again. Why not apply it to this problem, and, as Dr. Taylor suggests, keep the windows of the ordinary school-room open?

I recently had a sad experience with one of my patients. She was a little girl who had recovered in the Tuberculosis Class. When we sent her back to school last January she was the picture of health and felt perfectly well. I did not communicate with the teacher, and the Class nurse neglected to do so. We took it for granted that the teacher would do her part so that the health of the child would not suffer.

In May we discovered that she had lost fourteen pounds of weight. She had high fever and a rapid pulse. Tuberculosis lymph nodes in the axillæ were greatly enlarged and acutely inflamed.

On inquiry I found that she had been placed at a desk close beside a radiator, and that the air of the school-room was bad.

The cures reported by Dr. Brannan indicate that it is a simple matter to prevent relapses in arrested cases of tuberculosis if there is fresh air in the school-room. I should like to know how many of the cases relapsed after they were sent back to the regular schools.

Dr. E. R. BALDWIN: I would like to know if at any time there was noted any trouble from the effect of light on the eyes of these children who are lying out for their rest period in the sun.

Dr. E. O. OTIS: With regard to the matter of feeding these children: How many luncheons are they required to have, and are they provided by the school authorities, or who pays for them?

Dr. J. MADISON TAYLOR (Philadelphia): How are we to get the interest and co-operation of these teachers in the ordinary school-rooms? I have had a number of school-teachers as patients, and I have found many of them deeply resentful—that they are personally against the whole thing. I show them how they themselves will profit by this far more than the children, and that is a point which we should take up when any come for medical advice.

Dr. GORDON WILSON: It is not only the question of the opposition of the teacher to the open window that has to be met, but also the opposition of the parents, and my experience has been that the latter is the greater and the more difficult to overcome. To meet such questions as this, the School Board in Baltimore has appointed a sub-committee from its own body, which committee is known as the Hygienic Committee, and they decide upon all matters which, directly or indirectly, affect the health of the children, and as this Committee has two prominent physicians on it we have great hopes that the things that Dr. Brannan recommends will be carried out with a minimum of opposition.

Dr. J. H. LOWMAN (Cleveland, Ohio): With regard to the open-air schools, it was the practice in Chicago to ask the parents if they wished their children taught in open rooms. At first only a few were induced to try it, and the experiment went on for two years, while now every room of the twenty-four but two is open in the Graham School. When the rooms were opened for the first time in one class after three months' tuition the teacher declared the children were ready for promotion, the children apparently having covered the work usually required for nine months in the three months.

With regard to tuberculous children, we tried to estimate them and found 368 cases of tuberculosis in families in the district of that school. We found tuberculosis in 15—20 per cent. of the children coming from a family where there was some taint of this disease, and estimating from that, we concluded that there were ninety cases of tuberculosis in the school. We went to the School Board with that statement. Another statement made was that now the children are obliged to go to school and such cases are backward pupils, and each child costs $50 a year to educate. These children will, in all probability, spend two years longer before they reach the standard required. Now almost anything which will improve the hygiene of the school will diminish the time the child has to go to school. The percentage of attendance is increased enormously, and the school standard has advanced. So that they save actually one or two years by the dispensary, the nurse and simple inspection. If a child advances in six months as much as he did in nine, you will actually diminish the child's time in the school from one to two years, and the expense to the State will be approximately less.

Dr. J. W. BRANNAN: Dr. Otis has asked who furnishes the food for the children in the open-air classes in the public schools. In New York, as elsewhere, the classes are carried on by several agencies working in combination. The city, through the Board of Education, supplies the buildings, the teachers, the books and the extra clothing, such as hoods, sleeping-out bags, felt slippers and blankets. The Tuberculosis Committee of the Charity Organization, a private society, furnishes the food. Dr. I. Ogden Woodruff, an assistant of Dr.

Miller at Bellevue, makes all the examination of the children, and has them under his personal supervision. He has given his services without pay, but we hope this year to have him placed on the salary list of the Board of Education.

We have found no opposition among the teachers. They have suffered so much themselves from the foul air of the school-rooms that they welcome the suggestion of open windows and really fresh air. It is sometimes difficult to find a suitable room with kitchen facilities. Fortunately in many of the schools there is some arrangement for preparing and serving food. Dr. Maxwell thinks the time will come when every school child will be properly fed; if he cannot be fed at home he will be fed at school at cost price. Some of the superintendents have their doubts at first, but in every school in which we have established a class the superintendent has been won over. You have to make the same demonstration in the hospitals to the nurses and the doctors, but I feel convinced that in the course of a few years, instead of putting expensive ventilating systems in our public schools and in our hospitals we shall have the money to use for something else, and by proper window ventilation have fresh air coming in directly from the outside.

As to the effect of the light on the eyes of the children outdoors, I cannot answer, but I have not had my attention drawn to any ill-effects; you will notice that during the rest hour the children sleep turned away from the light. As to the ultimate results, the children all gain in weight and thrive in every way. There are nurses attached to all the schools, furnished by the Board of Health, and they go to the homes of the children to instruct the parents in sanitation and hygiene. Unfortunately, very few of the nurses can speak the language of the parents when these are foreign-born. It has been suggested that the Civil Service Commission establish a preferred list for nurses who can speak some of the continental languages.

The food of the children who had been selected for the first fresh-air class in the public schools was certainly astonishing. One Italian boy said that he always took whisky in his coffee; the majority had beer or wine with their dinner, which consisted of a little bread, supplemented with ice-cream, candy, cake, &c., taken at odd times during the day. Scarcely one child in this class was accustomed to have a really wholesome meal. At first they would not eat the food provided at the school, but finally they learned to take whatever was offered them. The food, of course, accounts for a large part of their improvement. With regard to the transoms, my idea is that, if you have them open in the hallways, there is bound to be a good circulation of the air, provided the corridors have pure air. In the hallways and wards at Sea Breeze we have transoms everywhere, and in our hospitals in the city. In the public schools

I found that many of them have transoms in the corridors, but that they were closed; when you get them open the improvement is very marked. With regard to the length of time the children stay in the hospital schools, our principle at Sea Breeze is to keep the patient until he is well; we have had children who have been there for two or three years. There have been very few relapses. The same principle has been applied to the ferryboat schools. As to whether there have been relapses among the children who go back into other classes of the public schools, I do not know. But if this idea is carried out as it should be, when they return to the other schools they will still be going on with their fresh-air treatment.

Dr. Longstreet Taylor has suggested that cots would be better than extension chairs. You will notice in the hospital classes that we have cots or beds. When we proposed to establish open-air classes in the schools we found a strong objection to the use of the word tuberculosis, or anything suggesting the hospital; if we were to introduce cots into the school building we should be apt to have trouble, as they would suggest the hospital—sickness. It is also necessary to have something that will fold up and can be put away in small spaces. When the time comes for the rest hour, the desks are removed and the extension chairs are put in their place.

Dr. C. L. MINOR: One of the great sources of difficulty in this matter is that the majority of the American public are not enlightened on the subject of fresh air and do not like open windows, and hence, whatever the teachers' attitude, it is difficult to get properly ventilated school-rooms. I myself had to take my child out of a private school and have her taught at home because I found it impossible to induce the school authorities to open the school windows and keep their rooms properly ventilated, so that my girl came back from school with headaches and feeling badly and dull, which was promptly corrected when proper conditions of ventilation were obtained. However, it is going to take a long time to convince teachers that open windows will do no harm, and for a long time there will be a large and active opposition to it.

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